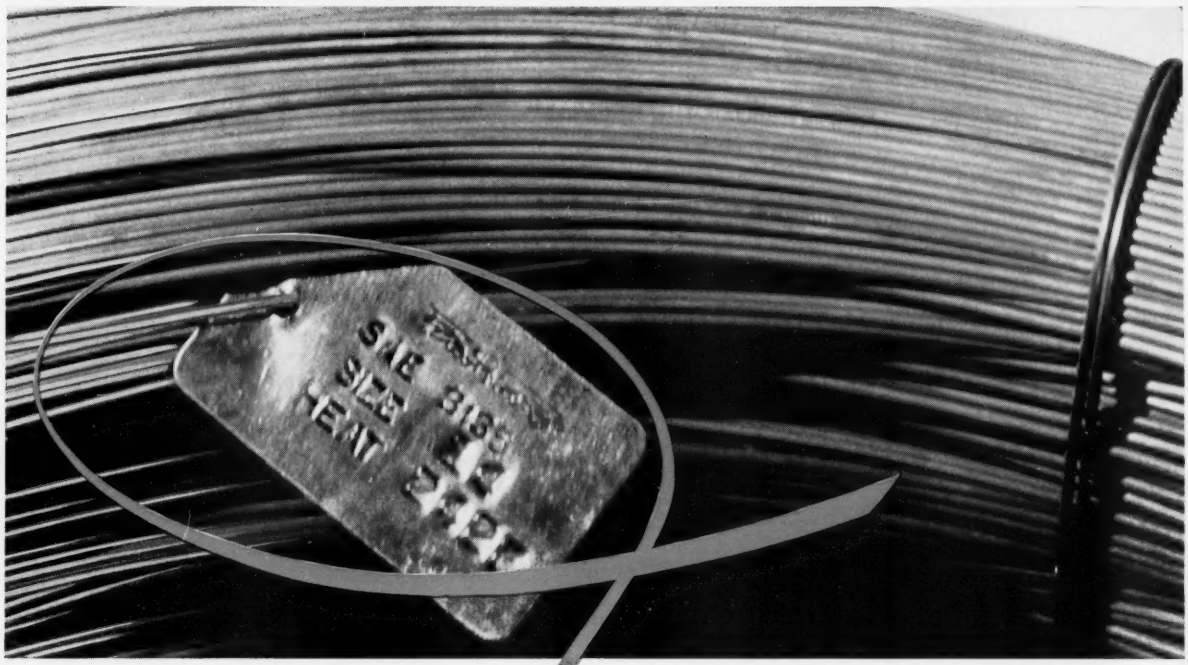
DECEMBER 1936

WIRE AND WIRE PRODUCTS



Tagged

FOR YOUR PROTECTION AND GUARANTY OF QUALITY SPECIFIED

● That there may be no possible chance for error, a metal tag into which is stamped heat number, size and grade is affixed to every coil of Republic Wire or Rod as it comes from the reel. Write Department WP for catalog 226-B—it tells the full story.

Republic Steel
CORPORATION
GENERAL OFFICES CLEVELAND, OHIO

REPUBLIC STEEL

WIRE DIVISION . . . OFFICES AND PLANTS
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COAT & HAT HOOK WIRE
COLD HEADING WIRE
HINGE WIRE
MACHINE SCREW WIRE
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RIVET WIRE
SCREW STOCK WIRE
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SPRING WIRE
WOOD SCREW WIRE
and seventeen
other grades.

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A shop-test of YOUNGSTOWN Manufacturers Wire will quickly prove its accurate adherence to specified diameter and quality of surface. At the same time you will find that Youngstown Wire gives you that consistent uniformity of working qualities so necessary to smoothly-operating production schedules. Bright wire can be furnished in all sizes from 18-gauge to $^5/_8$" in diameter; galvanized from 18-gauge to $^5/_{16}$"; coppered from 18-gauge to $^3/_8$".

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Manufacturers of Carbon and Alloy Steels
GENERAL OFFICES: YOUNGSTOWN, OHIO

625

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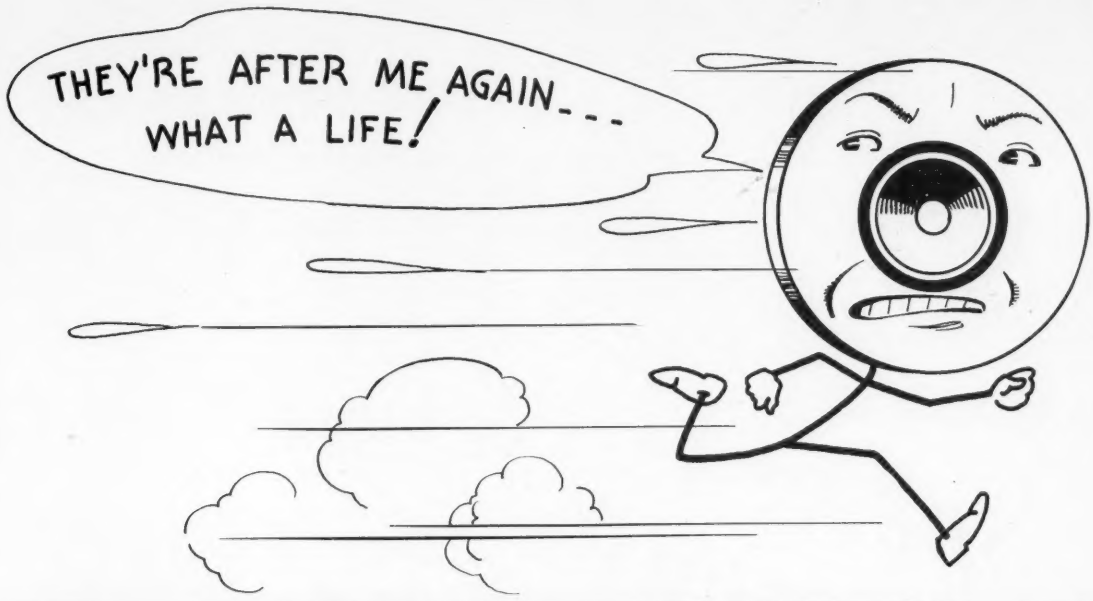

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Carboloy Engineering Service is designed to be of benefit to the user in three important ways. These are (1) Proper selection of nib sizes to do the most economical job in your plant, (2) Proper care and maintenance of Carboloy Dies, and (3) Correct use of Carboloy Dies in the mill.

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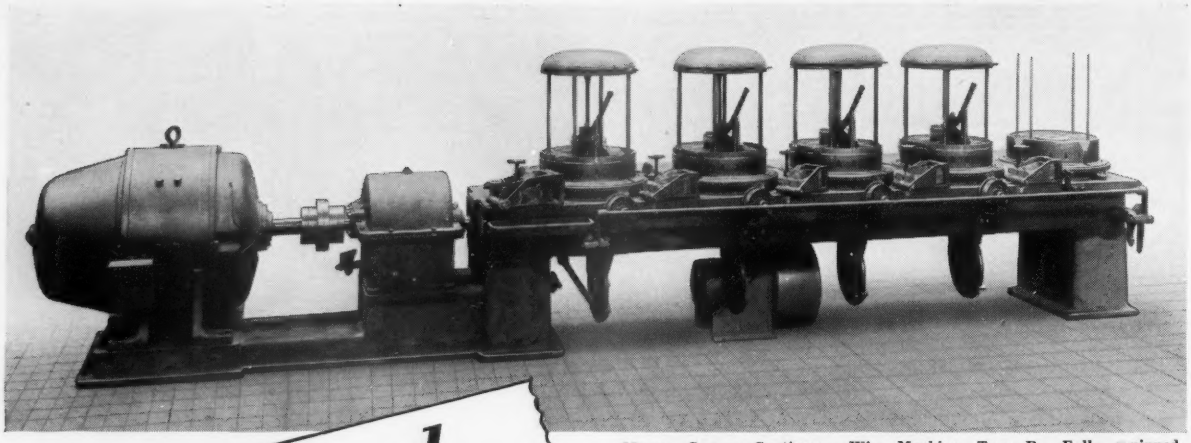
Authorized Distributors: Hartley Wire Die Co., Waterbury, Conn. Canada: Canadian General Electric Co., Ltd., Toronto.

CARBOLOY SERVICE

WIRE & WIRE PRODUCTS, Vol. 11, No. 12, December, 1936. Executive office, 17 East 42nd St., New York, N. Y. Published by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secretary and Treasurer. Publication office, 13 West Church Street, Washington, N. J. Subscription price: U. S., $5.00; Canada, $5.00 per year, 50 cents per copy; Foreign, $7.50 per year. Entered as second class mail at the Post Office, Washington, N. J., under Act of March, 1879.



Morgan-Connor Continuous Wire Machine, Type B. Fully equipped with motor and control, air-cooling system, clutches and safety stops. Designed to start from commercial No. 5 rod in either high carbon or softer grades.

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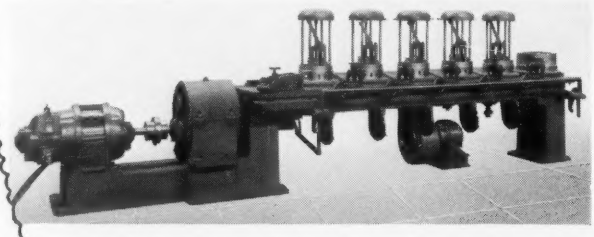
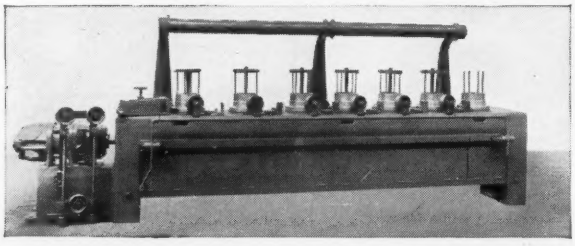


Morgan-Connor Continuous Wire Machine, Type C. Fully equipped with motor and control, clutches and safety stop. Machine takes wire either hard drawn or annealed. Patented wire can be started at about 11 gauge.



Morgan-Connor Continuous Wire Machine, Type D. This machine is designed especially for the drawing of finer sized wire. Starts from No. 17 patented wire.

"Speed . . ." Sustained high speed drawing means greater tonnage from your machines—more miles of wire from your operators. And, all things being equal, greater production means lowered costs per ton—larger profits from the finished product.

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W10

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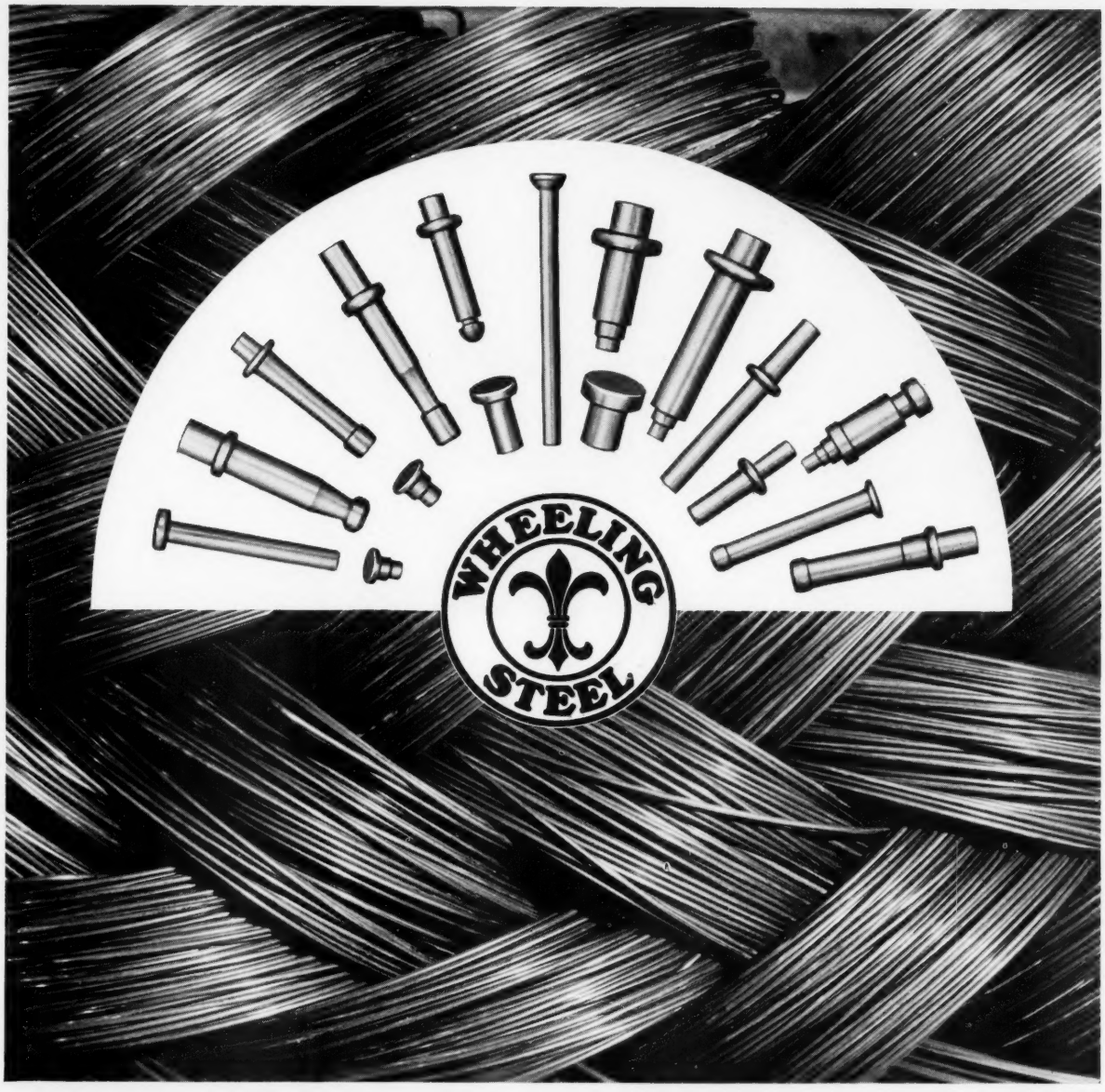
MORGAN Wire Machines

MORGAN WORCESTER ENGINEERS AND MANUFACTURERS



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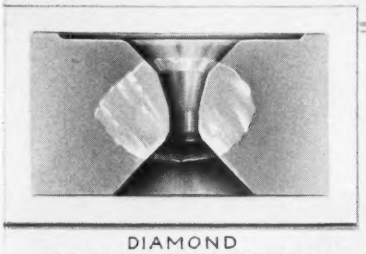

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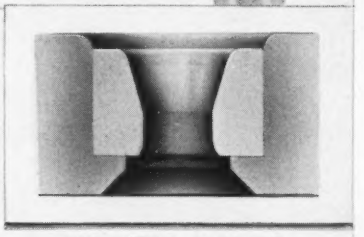

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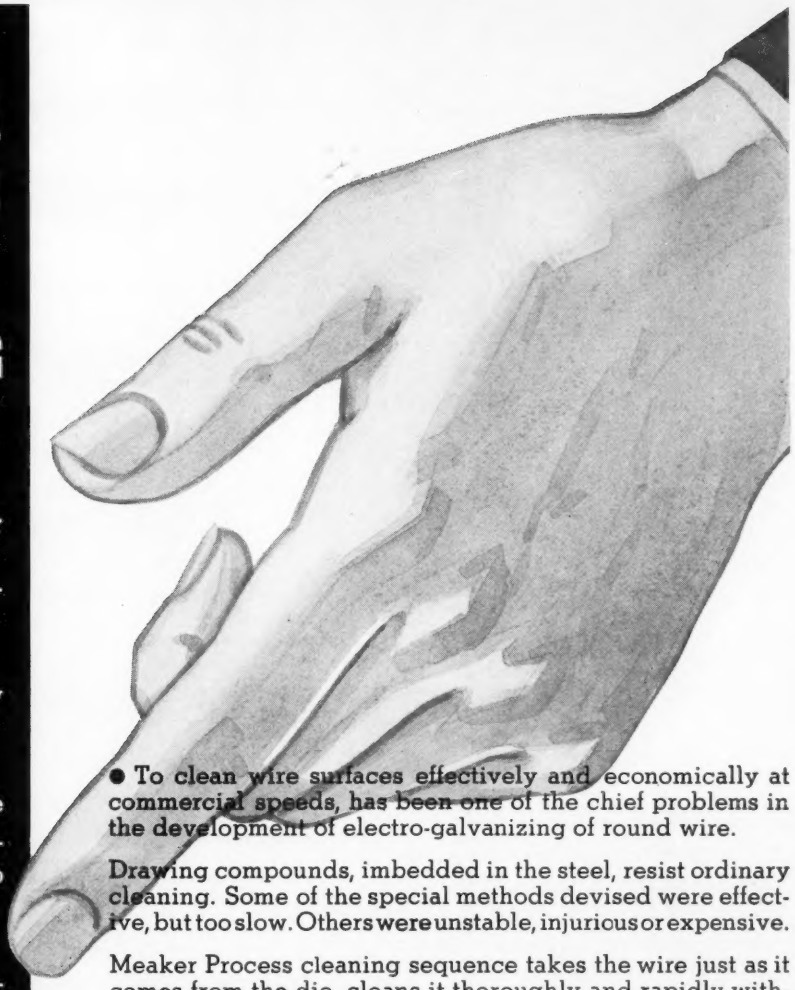

● To clean wire surfaces effectively and economically at commercial speeds, has been one of the chief problems in the development of electro-galvanizing of round wire.

Drawing compounds, imbedded in the steel, resist ordinary cleaning. Some of the special methods devised were effective, but too slow. Others were unstable, injurious or expensive.

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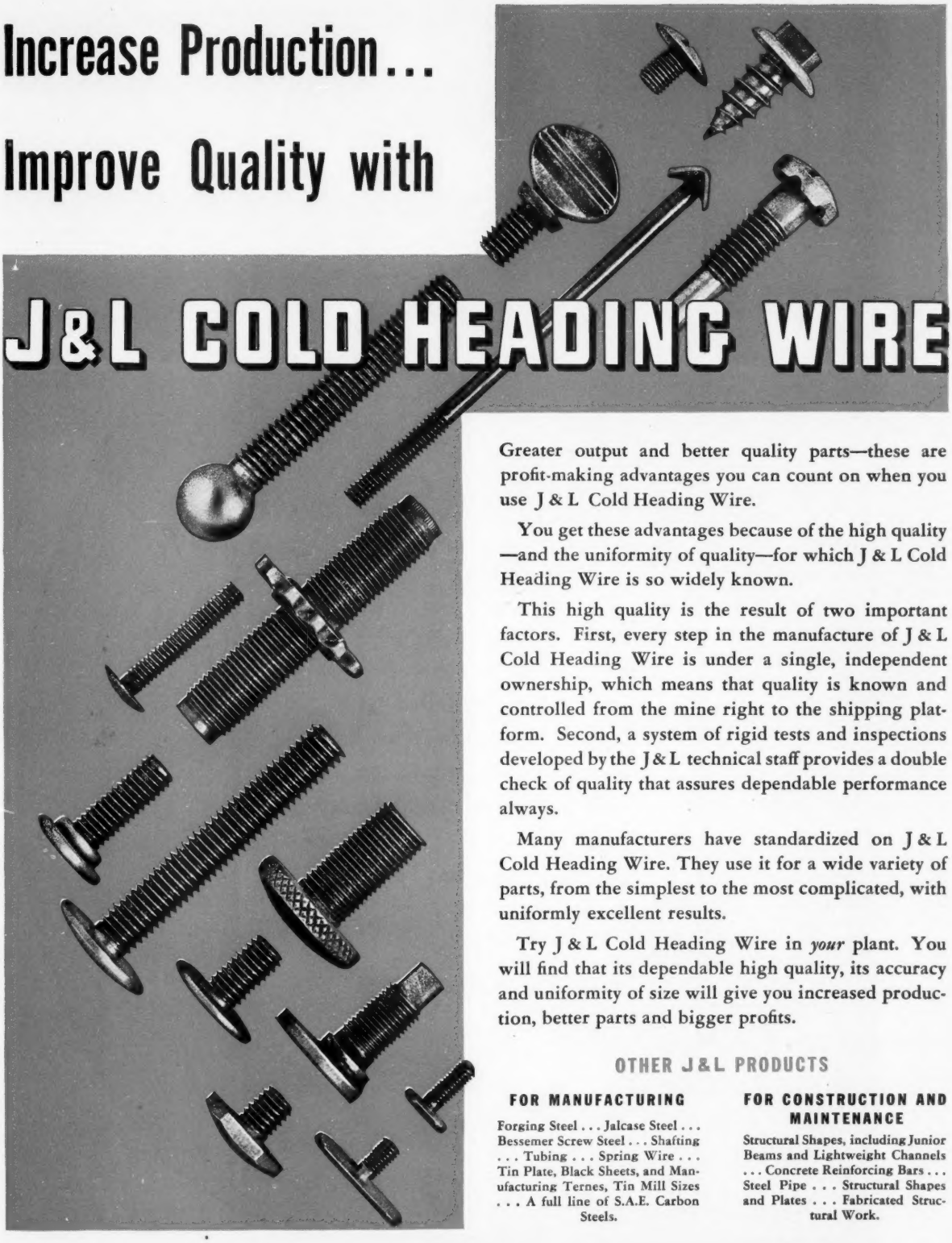

Greater output and better quality parts—these are profit-making advantages you can count on when you use J & L Cold Heading Wire.

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Air view of Laclede's Alton Works, where Laclede Wire is produced.

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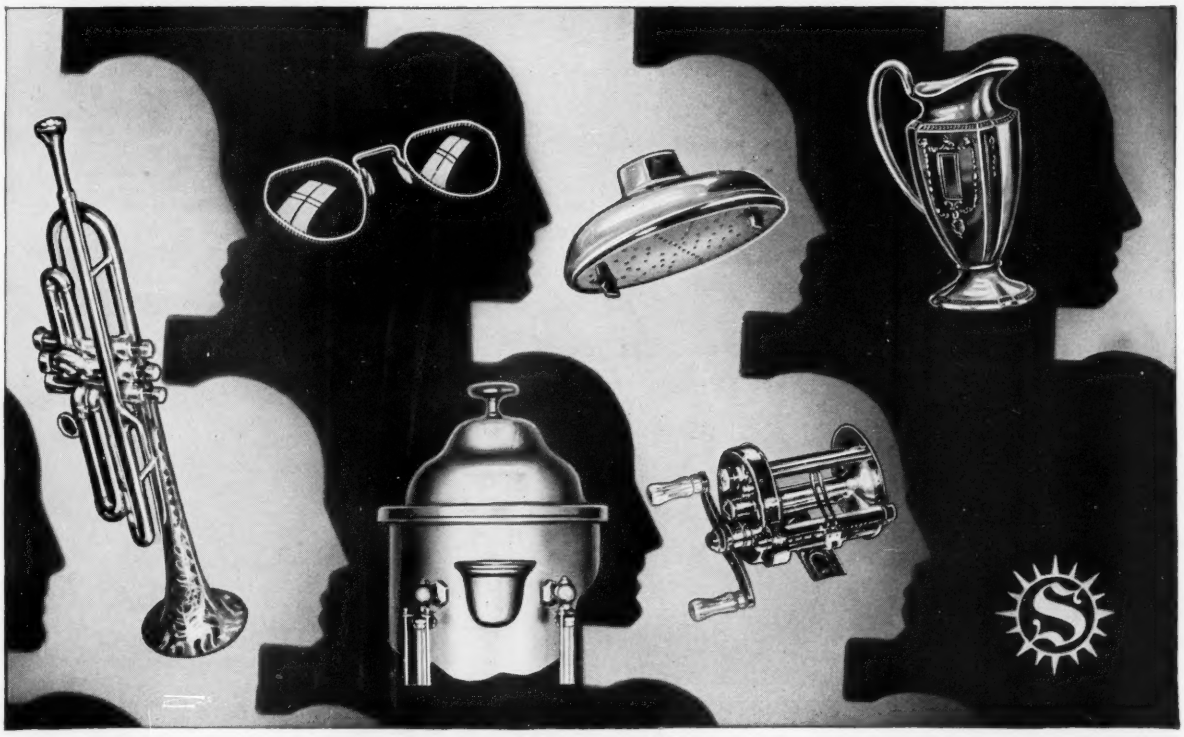
ST. LOUIS



relatives under the skin . . . . .

Articles almost without number, often as different in character as the reel on your fishing rod and the silver plate on your sideboard, are relatives "under the skin"! For under the skin, or plating, will be found a base of Nickel Silver. For more than forty years, Seymour Nickel Silver has been a preferred base in this widely varying field of plated ware.

Seymour Nickel Silver, an alloy of pure nickel, copper and zinc, is an ideal base for nickel, chromium and silver plating because of its silvery white color. When the plating finally wears through, the color of the Nickel Silver base resembles the remaining plate, leaving no telltale yellowish spots.

It is a favored alloy for stamped, spun and drawn articles, plated or unplated, because of its uniform, easily controlled ductility. It flows smoothly under die or spinning tool and emerges with a fine, even surface, free from troublesome cracks and granular areas.

It is available in sheet, wire and rod of varying nickel content. Perhaps its use would improve some phase of your production. To determine this, we will gladly send you samples for test—free and without obligation.

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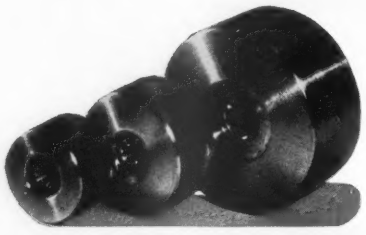
"Not a better die
but the best"



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Because the depression is over is no reason to forget the lessons it taught.

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Longer wearing dies; faster and more accurate recutting equipment play their part.

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A monthly publication devoted to the production of Wire, Rod and Strip Wire Products and Insulated Wire and Cable

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 11 December 1936 No. 12

Designated as

Official Publication By The Wire Association

Contents

Vacuum Lead Sheath as Applied to Power Cable ..... By R. W. Atkinson 695

The Manufacture of Wire Springs ..... By J. W. Rockefeller, Jr. 705

Methods of manufacturing wire springs including heat treating; spring finishes—choice and method of application; pre-tempered wire; annealed wire, etc.

Development and Standardization of Types of Military Equipment ..... By Captain Frank W. Bullock 709

A paper presented before The Wire Association Meeting at Cleveland, Ohio, October, 1936, outlining what the arsenals and laboratories seek to accomplish and how they go about it together with experiences to demonstrate the importance of the work of these agencies.

Outstanding Personalities of the Wire Industry 715

Exports and Imports of Wire 716

A Review of Recent Wire Patents 718

'Round the World with the Wire Industry 721

British Institute of Metals—Digest of Papers 730

Index to Articles, Volume 11, January to December, 1936, Inclusive 735-737

Index to Advertisers 738

Buyers' Guide 739-740

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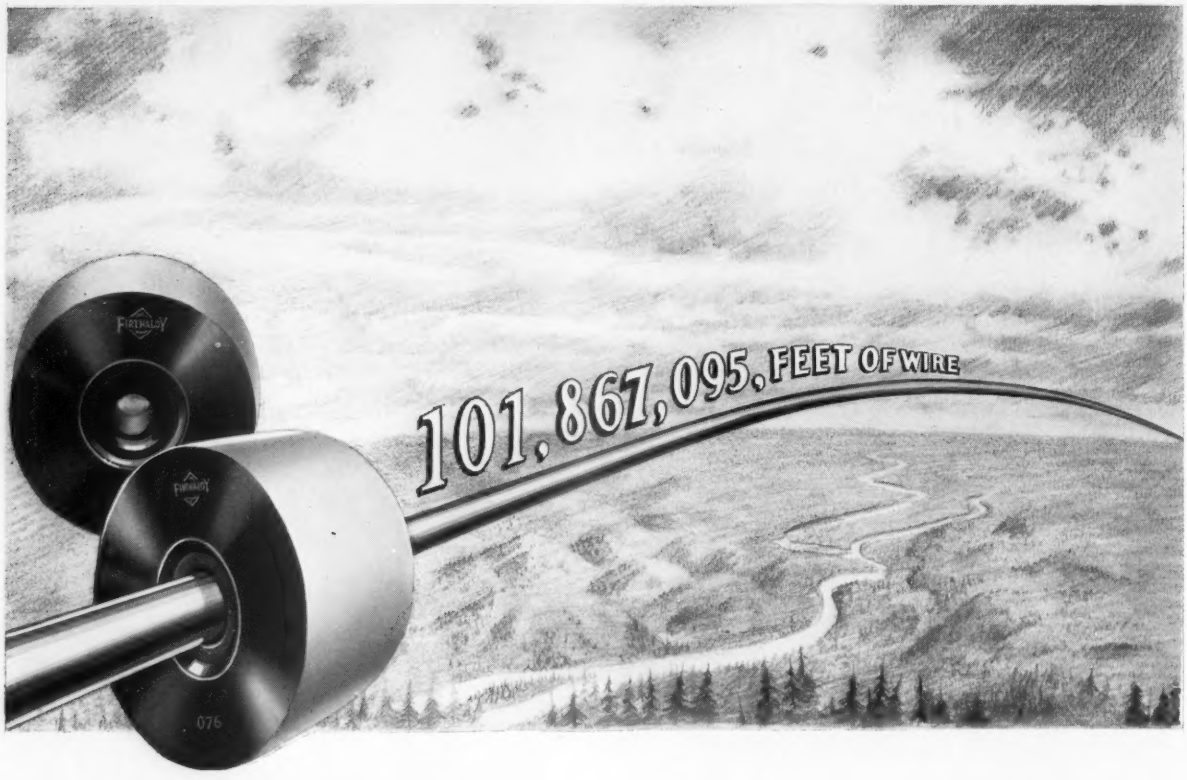

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WHEN you use Firthaloy Dies you are assured maximum results with precision performances. Two Firthaloy Dies size .076, purchased by a prominent wire manufacturer, for drawing low carbon wire, drew 4,397,120 pounds of wire and the dies are still in service. The 4,397,120 pounds of wire were in gauges as shown on the table below. The quantity of wire in each gauge converted into miles gives 19,293 miles of wire. The price of the dies was only $16.00 each.

When performance and cost of Firthaloy dies are compared, why consider any other type of wire drawing dies?

GAUGES	WEIGHT DRAWN in Pounds	FEET
14¼	94,330	9,575,677
14	* 69,770	6,349,076
13	93,350	6,739,586
12½	110,930	7,083,652
12	127,415	7,294,195
11½	* 64,220	3,251,975
11	131,755	5,981,754
10½	* 67,105	2,695,088
10	91,335	3,288,744
9½	* 59,130	1,883,181
8½	381,910	9,645,409
8	439,025	9,940,788
7½	460,355	9,230,175
7	347,370	6,238,125
6	250,905	2,279,665
5	478,070	3,727,351
4	277,145	1,846,279
3	853,000	4,798,335
TOTAL	4,397,120	101,867,095 or 19,293 miles

*Recut before dies went off size—
These dies still in service.

FIRTH-STERLING STEEL COMPANY

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Vacuum Lead Sheath As Applied To Power Cable*

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THOUGH lead pipes for water were used in the time of the Roman Empire, the first commercial use of lead used for the protection of cable insulation was on Signal Cables about the year 1880. After this there was a limited use on 110-volt d-c. cables, so that a few years later with the advent of the a-c. system, just half a century ago, this type of construction was ready for extended use with electric power cables. During this time enormous progress has taken place in cable construction. The electrical characteristics of the paper have been greatly improved; new and superior saturants have been developed; methods of application of the paper and of saturation have been revolutionized; and even fabrication of copper conductors themselves has been subjected to careful study, as a result of which marked improvements have been achieved. Indeed, with the single exception of the lead sheath and its application, every element in the cable makeup as well as every process in its manufacture has been a subject of intensive research to improve the finished product. But until very recently, comparatively little technical study has been given to the possibility of improving methods of fabrication of lead sheath.

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Originally associated with the Standard Underground Cable Co. as assistant to Henry W. Fisher in 1908. First under Mr. Fisher and then as Chief Electrical Engineer of that Company, he was intimately associated with the Engineering Development of wires and cables. With the union of companies forming the General Cable Corporation, he has been in charge of that company's Research and Development of high voltage cables. He is today regarded as one of the outstanding cable engineers of the country. With Mr. Fisher and alone, he has been granted many patents. Mostly in the field of high voltage insulation. It has been his ambition to translate into practical commercial uses the theoretical knowledge obtainable in the laboratory and with the slide rule. One effective means of accomplishing this has been to translate the abstract electrical or technical requirements into specifications for mechanical performance and thus to secure the cooperation of those skilled along other lines in the consummation of the desired result. The development of the vacuum lead press is a case in point.

IN spite of the antiquity of its use, very little was known of lead. No consideration was commonly given to its crystalline formation, and it was assumed that an extruded pipe was, of necessity, substantially homogeneous throughout its length. Consequently a discussion of the vacuum press becomes, to a large degree, a story of the conditions not existing in sheath made by this process, but that had hitherto been normally present in good sheath.

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PERHAPS the long neglect of lead was due partly to this presumption of homogeneity of structure, and even more to the almost perfect performance of the early installations of lead sheath when not subjected to abnormal operating conditions, such as mechanical injury, corrosive electrolytes, or excessive internal pressures.

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THE improvements in the materials and processes of manufacturing cable mentioned above, largely eliminating failures due to inherent defects in the insulation, caused greater emphasis to fall on those troubles which were attributed to sheath failure, and at the same time the greater initial

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perfection of the saturation of the cables, and the consequent absence of voids or gas bubbles to furnish a cushioning action, resulted in greatly increased internal pressures due to heat cycles under variations in cable loading. The growing use in higher voltage cables of fluid joint filling and pressure reservoirs, by helping to maintain the initial completeness of saturation throughout the life of the cable, added to this effect. As a result, during a period in which there was a reduction in the total number of cable failures from all causes, the number attributed to the sheath actually increased.

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COMING as it did after the long period of almost complete confidence in lead as a protective covering for cable insulation, and with the causes not generally understood for this sudden appearance of the somewhat widespread occurrences of cable trouble attributed to sheath failure; it is not surprising that there was much criticism of the manufacturers and emphatic statements that the sheaths involved in these failures were not so well fabricated as they should have been, in brief, that the troubles were due to defective sheaths. And examination of the sheaths near the point of breakdown in cases where the evidence had not all been destroyed by the arcing at the time of failure did reveal occasional occurrences of split lead, dross inclusions, lumps of red lead, etc. It was evident that dross, red lead and other solid non-metallic inclusions of sufficient extent to cause penetration of the sheath could be eliminated by better methods of extrusion and more careful inspection; and practically all power cable manufacturers quickly adopted measures aiming to accomplish this result. Also, to achieve a better bond between successive charges in the press, and to contribute to uniformity, improved methods of skimming the molten charge in the press cylinder were devised; better temperature control was utilized; and closer supervision was given to all the details of operation at the press.

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HOWEVER, it soon became apparent that only a comparatively minor number of bursts in sheaths occurred as a result of clearly defective or abnormal sheath, and microscopic study revealed that even in the best normal sheath there were wide departures from the uniform, homegeneous structure which had been assumed to be characteristics of good lead. The most prominent of the zones of non-homogeneity were found to be in the region where the lead from two successive charges join and form characteristic patterns which appear as the tongues and flow lines on the surface of prepared and etched samples.

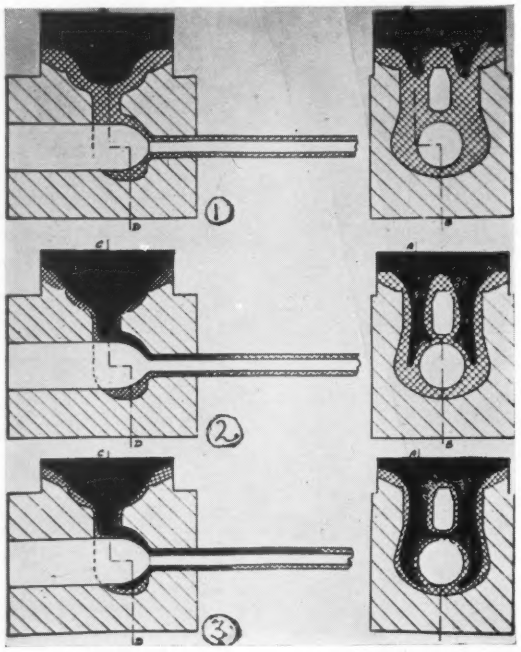

Fig. 1—Diagram showing the flow of lead during extrusion of lead cable sheaths. Black area shows new charge, cross-hatched area, old charge.

(1) Surface of old charge depressed over openings into die block very shortly after start of extrusion stroke.

(2) A little later in stroke the lead from the new charge has penetrated that of the old so that metal from the two charges is being extruded together.

(3) Still later in stroke, the lead from the old charge almost completely eliminated. ✦ ✦ ✦ ✦ ✦ ✦

THE way in which these patterns are formed can perhaps be better understood by reference to the mechanics of the lead flow in the press cylinder. This is shown in a general way in Fig. 1. In this figure, which shows diagrams of side and front sections of the lower end of the cylinder and the die block of a common type of press at various parts of the extrusion stroke, the lead left in the press cylinder and die block from the previous charge is indicated by the fine cross hatching, while the lead from the new charge is shown in solid black. In the upper diagram, which shows the condition just after the start of extrusion, it will be noted that the top surface of the lead left in the cylinder which was originally level has already been depressed in the region over the openings into the die block. The second diagram shows how the displacement of the cooler lead remaining from the old charge by the hot lead of the new charge proceeds. The residual lead does not move out as a mass ahead of the new charge; but, the central portion of metal flowing the fastest, the lead from the new charge penetrates that from the old, forming two streams through the openings into the die block and at the sides of the core. These streams are accompanied by a slower movement of the adjacent metal from the old charge, with the progressive elimination of the old charge. The lower diagram shows this process about completed, practically the entire die block and the lower end of the cylinder being occupied by the lead of the fresh charge, remnants of the old charge still showing only at the corners of the cylinder and near the walls and bottom of the block.

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IF we examine successive cross sections taken at intervals along the lead sheath

from a single extrusion length, we find a condition somewhat like that shown in Fig. 2, which shows sketches representing the distribution of lead from two successive charges. The footage references indicate distances along the sheath measured from the press mark at the beginning of the extrusion stroke. While the precise pattern formed and the place in the extrusion stroke of the press at which they appear varies greatly with the type of equipment, size of sheath, and details of operation, these diagrams represent in a general way the normal course of the cycle. It will be noted that in this particular case no lead from the new charge had begun to appear until after 20 ft. of sheath had been extruded. At 45 ft., lead from the new charge forms a slender crescent at each side near the top of the sheath as it emerges from the press. As extrusion proceeds these crescents grow in all directions, so that within 5 ft. they cover approximately half of the total cross section. It is in this portion of the length, or in the next few feet, that non-metallic inclusions, persistent flow lines, laminations, or areas of fine grained structure (if any of these are present) are likely to have the greatest effect on the quality of the sheath. This portion of the sheath has been termed the "charge-weld" region. As the tongues approach each other at the top and at the bottom of the sheath they become more and more rounded until they merge together to define the narrow radial regions which are ordinarily termed "welds".

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FIG. 3 shows the structure commonly found in sheath in the "charge-weld" region. In this sample there may be seen several areas of small grains extending through the large grained structure. These small grain regions occur principally adjacent to the line which we have seen marks the division between the lead from the new charge and that from the old, and near the ends of the tongues. Previous to the time when the intensive study of lead sheaths was begun, it was well known that the small grained structure produced locally in lead by cold working disappears due to the recrystallization which takes place on aging even at room temperature, and more rapidly at higher temperatures. But miscroscopic study revealed that in normal extruded sheath the small grained structure occurring along the flow lines and more extensively at the "tongues" persists through the life of the cable and, in fact, can be readily found even in samples which have been annealed at high temperature. As we have seen, these persistent markings appear to a marked degree only in that region formed by the junction between successive lead press charges and the patterns found in etched cross sections vary considerably in form and in extent, depending on the particular types of press and die block, and on details of press operation, length of slug, temperature, etc. The precise nature of these lines and the mechanism causing their persistence has never been agreed upon by the many different inves-

20 Ft. After Start
Lead from New Charge not yet started.
Tongues from previous charge
45 Ft. After Start
Lead from New Charge just appearing.
Lower tongues
50 Ft. After Start
New Charge Extends Over about 1/2 Total Area
Lower tongues
55 Ft. After Start
New Charge Extends over about 3/5 Total Area
Lower tongues
80 Ft. After Start
New Charge Extends over about 15/16 Total Area. Upper Tongue practically merged in Weld.
Lower tongues
110 Ft. After Start
Very Little of Old Charge left.
Lower tongues

Fig. 2—Development of Flow Line and Tongue Patterns during Extrusion of a Charge. Shaded Areas show lead from New Charge. Non-shaded Areas are residual lead from Old Charge. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

tigators who have studied this problem, but it has been pretty well established that the presence of a very minute quantity of gas or air, or of lead oxide, interferes in some way with the process of recrystallization. Of course, where a considerable quantity of non-metallic substance is present, whether dross, remnants of lubricating material used on the ram or cylinder walls, oxides, or other impurities in solid form, or gas entrained in the lead as it enters the cylinder; these particles will tend to float at or near the top surface of the molten metal, and will there be trapped in the rapidly solidifying lead. These materials may be flattened out in the process of extrusion into thinly attenuated films which are extruded in that portion of the lead which is adjacent to the junction between charges, and form effective barriers to normal grain growth. By care in handling, more effective skimming, improvements in spout design which reduce the "foaming" and "spattering" with their consequent trapping of air or gas to a minimum, and by generally better foundry practice it has been possible to reduce the actual quantity of inclusions of this sort to a small amount; but it has not been possible by these means to eliminate the persistence of the small grained structure observed at the tongues and flow lines.

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IT may be worth while to point out here that in good sheath these regions revealed by etching as flow lines and tongues are not regions of weaknesses as determined by ordinary physical tests. In fact these regions have the usual characteristics of fine grained structure and have frequently been found to have greater hardness and tensile strength than other sections of the same sheath having a larger (normal) grain structure.

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THE resulting non-homogeneity in structure, however, does result in a considerable reduction in the ability of the sheath as a whole to withstand certain types of mechanical tests, and also results in a marked decrease in life under long-time bursting tests at elevated temperatures. This weakness is, of course, most pronounced in that portion of the sheath longitudinally which we have termed the "charge-weld" region. This region of prominent tongues and flow lines does not usually extend over more than 10% or 20% of the length of each charge, and its location in the charge may be anywhere from a few feet after the start up to the middle of the charge, depending on the design and method of operation of the press. In each direction from this region the effect grows progressively less, a considerable part of the cable adjacent both ends of each extrusion length (measured between successive press marks) being practically free from this type of non-homogeneity, even in cases where it appears in very pronounced form at the "charge-weld" region.

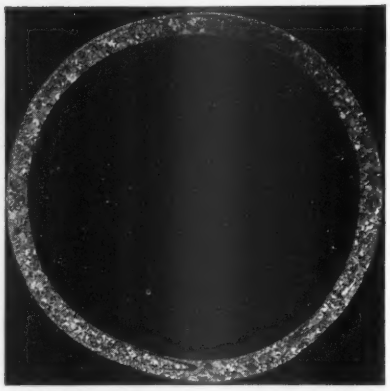

Fig. 3—Section of Non-vacuum Sheath Etched to Show Grain Structure. A—Upper Weld; B—Lower Weld; C, D, E, F—Tongues ✦ ✦

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THOUGH the remedial measures discussed above resulted in material improvement, we were convinced that this was only a start, and were determined to develop means by which these difficulties could be entirely eliminated. It had been assumed by many that the whole trouble came from the formation of oxides on the surface of the molten lead entering the cylinder, and, along with others, we first tried the use of a blanket of non-oxidizing gas in the cylinder and over the surface of the incoming stream of lead. By this means it was possible, with the use of sufficent care, substantially to prevent the oxide film which forms

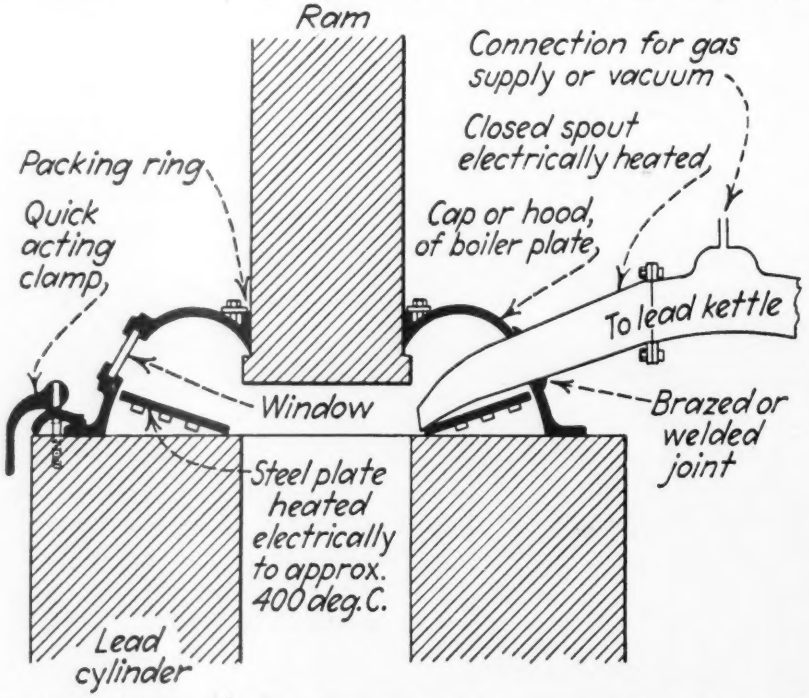

Fig. 4—Method of protection of lead from contamination by vacuum operation. Inverted type lead press (moving ram, stationary cylinder). ✦ ✦ ✦ ✦ ✦ ✦ ✦

almost instantaneously on the surface of molten lead exposed to air. The difficulty, however, of eliminating foaming and of preventing the rapidly cooling mass of lead from entrapping finely divided bubbles of gas suggested the desirability of getting rid of the gas altogether; that is, pouring under vacuum.

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THIS involved building an air-tight closure around the top of the cylinder, with an opening for the ram provided with an adequate stuffing box, and means for transferring the lead from the melting kettle to the cylinder without exposing it to the atmosphere. The way in which this was accomplished can be best understood by referring to the illustrations. Fig. 4, which shows a diagrammatic drawing of a press of the so-called inverted type (i. e., with stationary cylinder and moving ram) arranged for this type of operation. Here we have a simple metal hood mounted on the top of the lead press cylinder with a special vacuum tight stuffing box around the ram. Lead is admitted to the cylinder through a closed spout, the entire space within the spout, hood and lead press cylinder being maintained under high vacuum at all times.

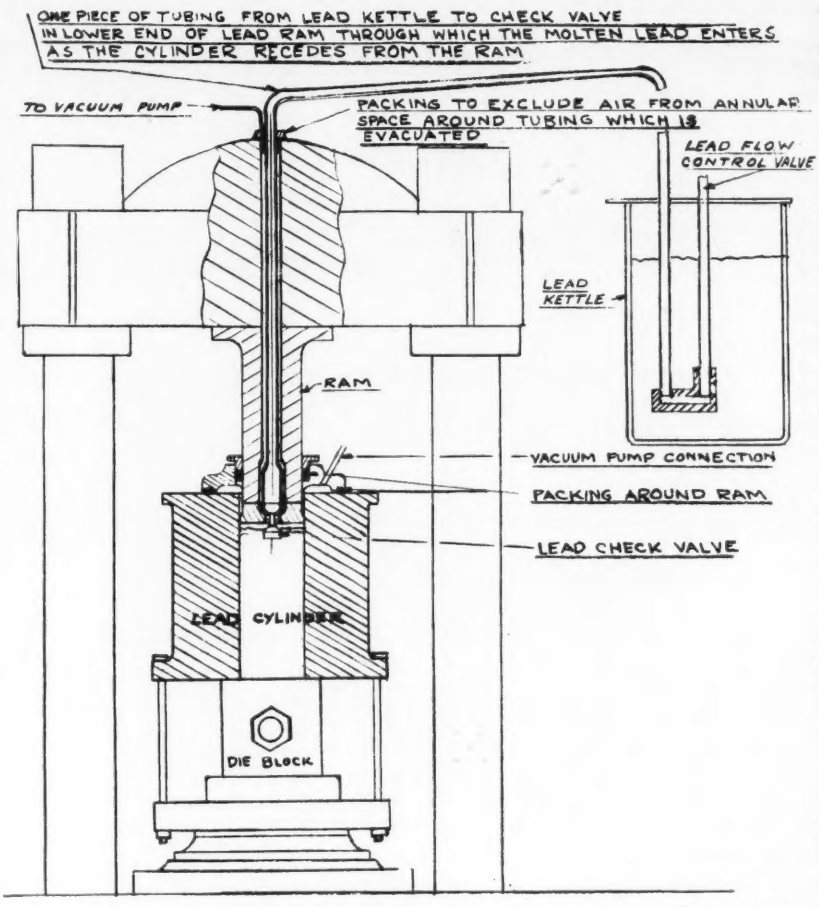
ONE PIECE OF TUBING FROM LEAD KETTLE TO CHECK VALVE IN LOWER END OF LEAD RAM THROUGH WHICH THE MOLTEN LEAD ENTERS AS THE CYLINDER RECEDES FROM THE RAM
TO VACUUM PUMP
PACKING TO EXCLUDE AIR FROM ANNULAR SPACE AROUND TUBING WHICH IS EVACUATED
LEAD FLOW CONTROL VALVE
LEAD KETTLE
RAM
VACUUM PUMP CONNECTION
PACKING AROUND RAM
LEAD CHECK VALVE
LEAD CYLINDER
DIE BLOCK

Fig. 5—Normal type lead press (stationary ram and moving cylinder) arranged for vacuum operation.

The lead shell which squeezes up around the ram is kept to a minimum by maintaining very small clearances between the nose of the ram and the cylinder, and this lead can either be melted by means of the hot plate shown and returned to the cylinder, or the hood may be opened up from time to time and the accumulated lead be removed. When the latter method of operation is followed, the ram is first run down upon the lead and held there under a pressure just below that required to start extrusion. The vacuum is then broken with an inert gas, which is permitted to flow while the hood is opened and the lead removed.

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FIG. 5 shows the complete layout of melting kettle and press as adapted to the normal type of press (i.e., stationary ram and moving cylinder). With this type

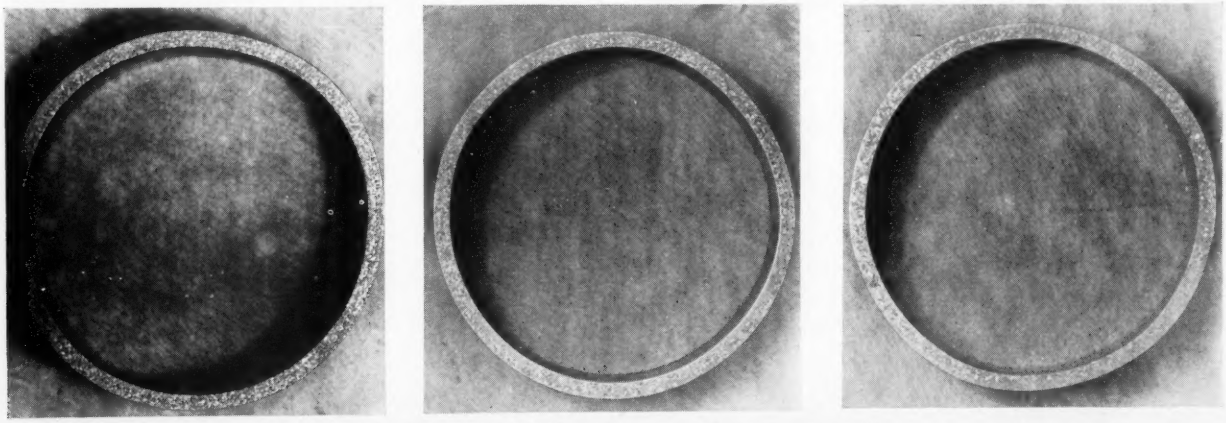
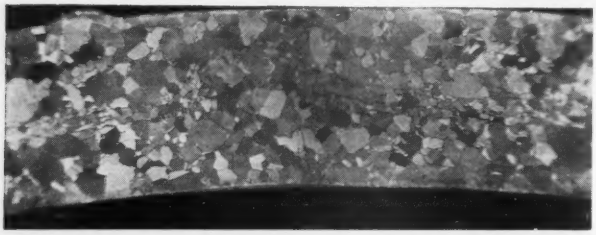


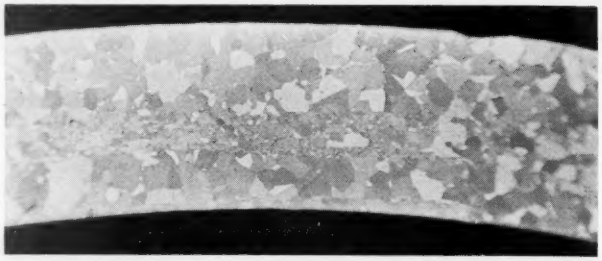
Fig. 6—Typical etched sections of vacuum and non-vacuum sheath.

(a) Non-vacuum sheath, previous to appearance of lead from new charge. ✦ ✦ ✦ (b) Non-vacuum sheath, charge-weld region. ✦ (c) Vacuum sheath, charge-weld region. ✦

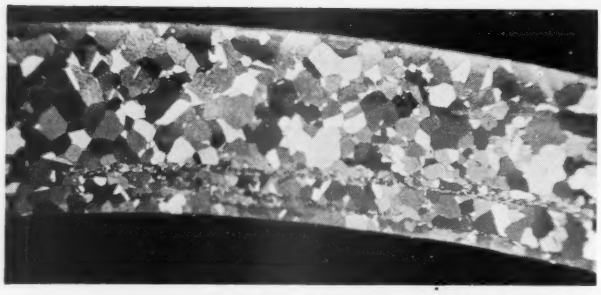
Fig. 7—Structure of non-vacuum sheath, 45 ft. after start of charge.



(a) Upper weld X9



(b) Right lower tongue X10

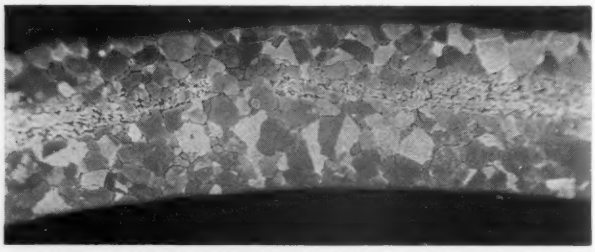


(c) Left lower tongue X10

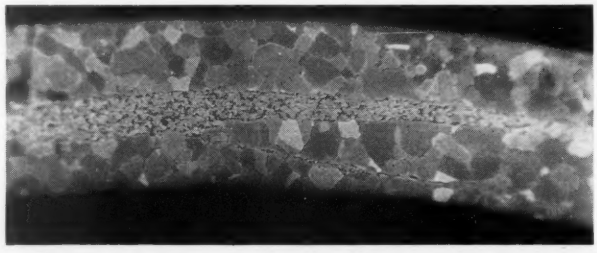
of press the lead supply pipe enters through a hole drilled longitudinally through the ram. The feed pipe is heat insulated; the part within the ram by a vacuum chamber around it and exposed portions by asbestos lagging. It is electrically heated throughout, and thermostatic control keeps it above lead melting temperature. In this press the filling is done as the cylinder is "backed down", so that splashing, and spattering of lead on the cylinder walls is reduced to a minimum. The ram is never withdrawn from the cylinder during operation, and this makes it possible to use an extremely small clearance between the ram nose and the cylinder wall, thus practically eliminating the formation of shell, the little that accumulates being removed from time to time as described above. With this type of operation it is not possible to observe the lead level during the filling of the cylinder. A simple and effective "lead level indicator", the operation of which depends on the quantity of lead admitted, enables the operator to know at all times during the filling of the cylinder the exact height of the lead and the clearance between the surface of the lead and the end of the ram.

IT will be observed that in this installation the molten lead is taken from a point in the melting kettle well below the surface and some distance from the walls or bottom so as to avoid the danger of entrapping particles of dross which might have formed on the metal surfaces. A metal "basket", well above this point, is arranged

Fig. 8—Structure of non-vacuum sheath, 50 ft. after start of charge.

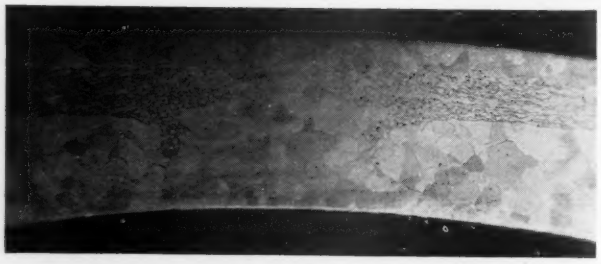


(a) Upper weld X8

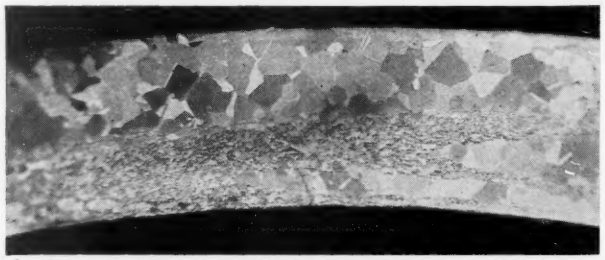


(b) Lower tongue X9

Fig. 9—Structure of non-vacuum sheath, 55 ft. after start of charge

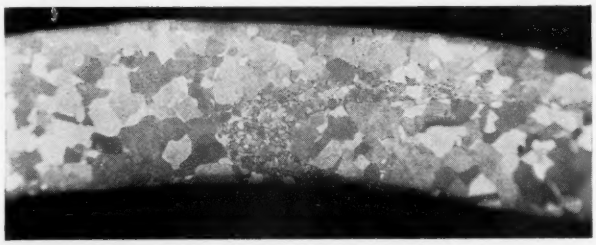


(a) Upper weld X9

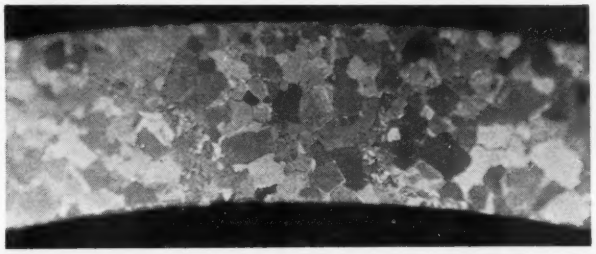


(b) Lower tongue X10

Fig. 10—Structure of non-vacuum sheath



(a) Lower tongue 80 ft. after start of extrusion X8



(b) Both lower tongues and weld 110 ft. after start of extrusion X10

to receive the lead pigs when the kettle is being recharged, and prevents them from carrying down particles of dross or oxide which may become temporarily lodged near the outlet and later be carried over into the press. The lead passes through a closed tube directly to the lead press cylinder, and is at no point permitted to come in contact with air or other gas. At the same time, means have been developed eliminating the necessity for lubrication of either the ram or cylinder walls between charges. Thus, for the first time it is possible to keep the lead absolutely clean and free from contamination of any kind from the time it leaves the melting kettle until it emerges from the press as extruded sheath.

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THE results obtained on sheaths extruded on this type of press have given evidence as to the cause of the persistence of the small grained areas in the region of the flow lines; and with common lead, where this condition is a result of the presence of minute quantities of oxide, gas, or other non-metallic inclusions, it has been possible to eliminate almost completely this type of non-homogeneity. In fact, it is only with the greatest care in preparation and by special methods of etching that the flow lines can be detected at all. These flow lines, in common lead made by the vacuum process, show merely a special orientation of grains, and not a difference in grain size as will be seen from the illustrations. (See Fig. 11).

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THE relative uniformity of structure of vacuum sheath as compared with that of non-vacuum sheath is clearly illustrated in the accompanying photographs of etched sections. The extrusion lengths of sheath made by the two processes from which the samples were selected for the making of these pictures were of identical grades of lead, and, except for those differences which are fundamental to the two types of operation, were extruded under the same press conditions.

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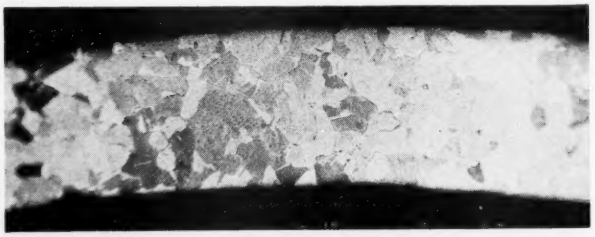
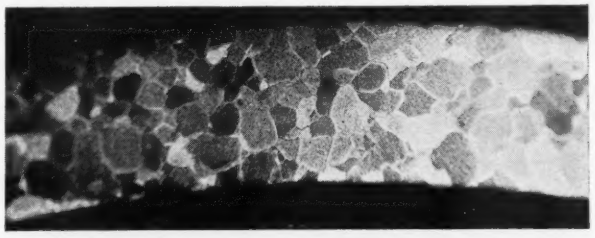
IN Fig. 6 we have typical examples of both types of sheath. The section (a) is from that portion of the non-vacuum sheath extruded before the lead from the new charge has begun to appear; while (b) and (c) are sections from the charge-weld regions (in this case 50 ft. after the start of extrusion) of non-vacuum sheath and vacuum sheath, respectively, and carefully selected from corresponding parts of the extrusion cycle. It will be noticed that in (a) the structure is rather uniform—not that the grains are all the same size, but the large and small grains are distributed over the whole section and there is no considerable area in

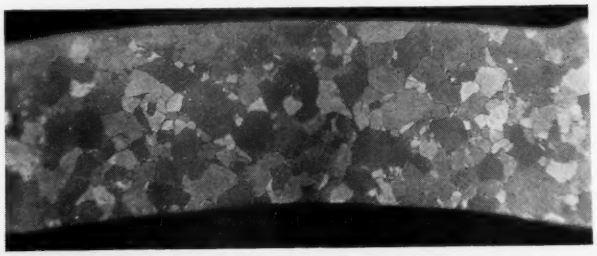
Fig. 11—Structure of vacuum sheath



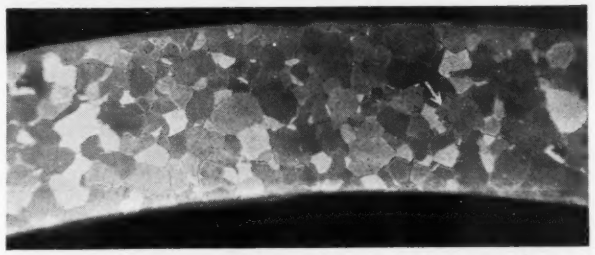
(a) Lower weld—50 ft. after start of extrusion X8



(b) Lower tongue—50 ft. after start of extrusion X8



(c) Upper weld—55 ft. after start of extrusion X10



(d) Lower tongue—55 ft. after start of extrusion X9

which the average size of grain is greatly different from elsewhere. The lines marking the upper and lower welds can be detected by careful examination as can the remnants of the lower tongues from the previous charge which are still far enough away from the weld to be observed as separate line. In (b) the tongues and flow lines are very distinct, and considerable areas of fine grained structure may be observed at the ends of the tongues. No tongues or flow lines are visible in (c), the structure being, if anything, actually more uniform than that in (a).

TABLE I

Average Results of Hydraulic-Time Tests on Lead Sheath
Vacuum sheath vs Non-vacuum sheath

	Temp. °C.	Stress in Lead lbs./sq. in.	Hours to Failure		Ratio: Vacuum / Non-vacuum
			Vacuum	Non-vacuum	
A Samples	60	540	211	156	135%
B Samples	60	540	191	103	185
C Samples	60	540	266	146	182
D Samples	60	540	230	239	97
A Samples	60	445	808	293	278
B Samples	60	445	1030	353	290
C Samples	60	445	1095	545	200

Samples A and B, adjacent samples so selected that one or the other will contain the region of most prominent flow lines.
Samples C selected from part of sheath about two-thirds way to end of charge.
Samples D selected from "best" part of charge.
All individual results reduced to Equivalent Time for Standard Stress.

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THE structure found at the flow lines and tongues in non-vacuum sheath and its development as extrusion proceeds is shown in Figs. 7 to 10 inclusive. Fig. 7 shows enlarged views of areas of the cross section at the top and sides of the sheath 45 ft. after the start of extrusion, which in this case is just after the first appearance of fresh lead from the new charge. In (a) the flow lines approaching the top weld are distinctly marked, while (b) and (c) show the narrow tongues which at this stage are at the sides of the pipe.

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FIG. 8 shows the upper weld and one of the lower tongues 5 ft. further along in the extrusion length, and Fig. 9 the same regions after 55 ft. of sheath has been extruded. At this point the lower tongues are becoming broader and more blunt, but are still some distance from the line marking the lower weld. Also, at about 55 ft. the flow lines reach the stage of greatest prominence and further along in the charge as the tongues still more closely approach the weld, at the same time growing more blunt and rounded, the markings become less distinct and the areas of the regions of small grains grow progressively smaller. This is shown in Fig. 10.

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THE comparison with vacuum sheath is shown in Fig. 11. The sections illustrated are from the charge - weld region and were selected to correspond to those of the non-vacuum sheath. Attention is called to the absence of any areas of small grain structure. In most cases it was impossible to detect any markings whatever on the etched surfaces to indicate the location of welds or flow lines. Close examination of (d) will, however, reveal a fine "V" shaped line extending into the picture from the right, the apex of the "V" being indicated by the arrow. This marks the lower tongue, and the striking similarity in shape with the broadly outlined tongue in (b) Fig. 9 gives evidence as to the correspondence between the samples. The contrast in structure needs no discussion. No additional photomicrographs of sections of vacuum sheath are being included as they could not be distinguished from those in Fig. 11. That is, except for the almost invisible outline of the tongue in Fig. 11, (d), the longitudinal uniformity of structure obtained by this process is so great that it is practically impossible to tell one etched section from any other, no matter what part of the length the samples come from.

TABLE II

Grand Summary of Hydraulic-Time Tests
Vacuum sheath vs Non-vacuum sheath

Temp. °C.	Stress in Lead lbs./sq. in.	Type of Sample	Average Hours to Failure
60	540	Vacuum	225
60	540	Non-vacuum	161
60	445	Vacuum	978
60	445	Non-vacuum	430
40	540	Vacuum	1313
40	540	Non-vacuum	707
40	445	Vacuum	*
40	445	Non-vacuum	1385

*Test discontinued after 2710 hours with 4 out of 6 samples still unbroken.

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BUT the proof of the pudding is in the eating, and it is not to be assumed that the mere appearance of structural non-homo-

geneity in the etched sample is objectionable, or that insistence on its elimination can be justified, unless the resultant product has improved physical characteristics. I have called attention to the fact that the lead in the small grained region is not necessarily weaker, but usually has, in fact, higher tensile strength than the surrounding large grained metal. Nor does this structure materially reduce the bursting strength or the percent expansion before bursting of pipes on ordinary short-time internal pressure tests. Common experience has shown, however, that in ordinary non-vacuum sheatns burst in service, the number of failures occurring in the region of prominent flow lines and tongues is entirely out of proportion to the number occurring in those portions of the sheath remote from the region, when the percentage of the sheath involved is taken into consideration.

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IN order to approximate service conditions more nearly than can be done with short-time tests we have submitted a large number of samples, maintained at different constant temperatures, to internal pressures sufficient to produce failure in a number of weeks or months. Samples of both vacuum and non-vacuum pipe, some selected from the region of maximum flow lines, and others from that part of the pipe remote from this region were tested in this way.

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THE summary of one group of tests given in Table I is typical of the relative performance.

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IN the test at 540 lbs. stress the life of that portion of the pipe which is the weakest was increased 85%, while in the D samples, which are furthest removed from the region of prominent flow lines, there was practically no difference between the non-vacuum and the vacuum samples. These results show a good correlation between life and the relative freedom from visible tongues and flow lines appearing in etched samples.

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THE samples at 445 lbs. stress, that is, those under the less accelerated test, show an even greater advantage for the vacuum process pipe.

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ADDITIONAL pressure-time tests were made on similar samples at two temperatures and two internal pressures. Table II gives a grand summary of the results of all these tests. We would point out that all of the samples shown as not having failed at 2400 hours were vacuum sheath.

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ANOTHER comparison was made using the I. P. C. E. A. bending tester. This is a modification of the simple vise bending test used for years by cable inspectors to detect laminations or other weakness under this type of stress. In this test, rings ½" wide are cut from the sheath, slit at one point, and opened up. One end is gripped between fixed jaws having a specified radius, and the free end is moved backward and forward through an arc of 180°, each movement through 90° being counted as one bend. This is repeated every ½" around the circumference, two adjacent rings being used and the breaks staggered so as to give a break at ¼" intervals around the sheath. Samples taken at frequent intervals longitudinally of one complete extrusion length of vacuum sheath and of a similar length of non-vacuum

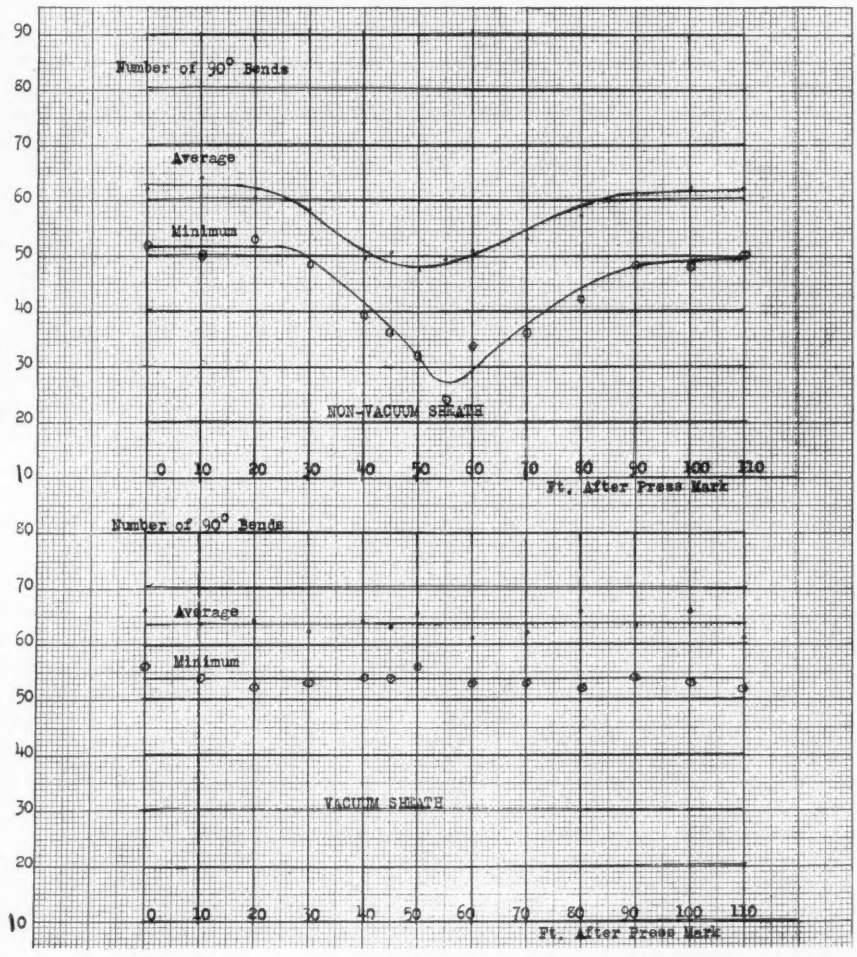

Fig. 12—Comparison of bending tests, vacuum vs. non-vacuum sheath. Two rings tested at each location.

sheath were subjected to this test. Fig. 12 shows the results of this test, the vertical scale representing the number of 90° bends required to break the sample and the horizontal scale the distance longitudinally from the start of the charge. Attention is called to the decided droop in the curve obtained on non-vacuum sheath in the region of most prominent flow lines, whereas there is no tendency of this sort in the vacuum samples. With the non-vacuum sheath many of the breaks in this region are rough and jagged and are more poorly necked down than elsewhere, but no such tendency is found in the vacuum sheath. We must, of course, use some discrimination in interpreting the results of this particular test. In the first place, it does not reproduce conditions normally found in service, and in the second place, it has not yet been developed to give high precision so far as reproducibility of number of bends is concerned. However, if interpreted with due allowance for its limitations, and especially if the nature of the breaks is given proper weight, this test does give reliably a rough indication as to the relative quality of lead sheaths made from identical grades of lead, and more especially as to the uniformity of the sheath throughout an individual cable. The matter of uniformity is in itself of some importance commercially, since the mere occurrence of any observable non-uniformity tends to give rise to doubts as to quality. Moreover, this test has been found to show reasonable correlation with life in service and with long-time tests. In this case it gives unmistakable confirmation of the results of the microscopic analysis and the pressure-time tests.

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IT is an interesting coincidence that the same thing which has contributed so much to the improvement of cable insulation, that is, the development of vacuum technique, now proves its worth in contributing to the effectiveness of the protection afforded to the insulation by the lead sheath. The ability of the lead to withstand without deterioration most conditions commonly to be met, its high malleability, its characteristic of time-annealing which tends to relieve internal strains due to cold working, and its freedom from brittleness, make it an ideal material for this purpose. This development, by preventing contact with non-metallic contaminants of any nature, makes it possible to maintain the clean metal delivered to the press in its original uncontaminated state, free from oxides or any solid or gaseous inclusions until it emerges into the air as completed sheath, and goes a long way toward assuring the maintenance of these characteristics to full degree and the complete realization of their advantages.

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By

ALASTAIR T. ADAM, A.R.T.C.

PHOTOGRAPHS, DIAGRAMS & TABLES

THE publication of the first edition of "Wire Drawing and the Cold Working of Steel" occurred over ten years ago, but in this age of technical development the progress made is so rapid that such a period is sufficiently lengthy to make any text-book out of date, and in the preparation of the second edition of this valuable work the author has not been so much surprised that much has had to be revised, or rewritten, as that any of the text could be left without modification.

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THE main scheme of the original edition has been retained with its intention of so presenting the subject that it may be of interest to both the wire manufacturer and the wire user. Some matter has been eliminated, but much has been added, notably an entirely new chapter dealing with typical applications of wire; and although some of the old text remains unaltered, every chapter has been completely revised and several entirely rewritten. The volume has also been re-illustrated with a large number of photographs, diagrams and tables. Thus has been brought fully up to date the author's intention to explain the real nature of cold-worked products, and to show how the physical properties required for a particular process may be obtained.

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The Manufacture of Wire Springs

By J. W. Rockefeller, Jr.

Consulting Engineer, New York, N. Y.

Methods of manufacturing wire springs including heat treating; spring finishes — choice and method of application; pretempered wire; annealed wire, etc. ✦ ✦ ✦ ✦ ✦ ✦

A GENERAL knowledge of the methods of manufacture of wire springs is important, not only to the spring maker, but to the manufacturer of spring wire and to the user of wire springs. A knowledge of the manner in which his product is used will often enable the wire manufacturer to render valuable assistance to the spring maker in the selection of raw materials, while an appreciation of spring making problems will often permit the user of springs to cooperate with the spring manufacturer in obtaining the desirable balance between costs and quality.

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TWO springs presenting an identical appearance to the naked eye may represent a difference in cost of manufacture of as much as one thousand percent. A purchasing agent asking for quotations on springs made to meet specifications outlined upon a single blue print may be confounded with prices ranging all the way from three cents to thirty cents each, in spite of the fact that all sources of supply have figured costs fairly and added but a fair margin of profit. "Spring steel wire", may mean almost any steel wire of carbon content greater than .50%, heat treatment may be omitted entirely or consist of but a single low temperature draw, and coiling may be performed at a lower or higher cost depending upon the tolerances which the finished spring must meet.

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IN a previous article of this series, some of the most common spring materials were discussed. Cost of manufacture will, of course depend to some extent on the material selected and also upon the care exercised in the treatment of the raw material in converting it into springs.

The Coiling of Springs

IN the manufacture of helical springs, the first operation performed upon the material is coiling or winding and this is usually accomplished by means of automatic coilers or winders.

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UNLESS the section of the wire or rod is too large to permit, the usual procedure is to coil or wind springs cold. On large rods it is necessary to heat to a forming temperature before the coiling operation. Helical springs of the compression or extension type are usually coiled upon a machine which forms the helix by tools or rolls which exert pressure upon the outside of the coil. The wire is forced against the forming tools or rolls by a feeding mechanism consisting of a series of feed rolls.

J. W. ROCKEFELLER, JR.

Graduated from Massachusetts Institute of Technology 1921. 1921-1928, John Chatillon and Sons, New York, N. Y., from which resigned as Works Manager to enter consulting field. Has been engaged in installation of spring plants and design and production of wire springs for firms in spring, spring balance, and automotive fields. Charts for calculation of helical springs, translated into Kilo-Cm basis and adopted by Italian Engineering Standards Committee, 1926. Secretary of Spring Research Committee of American Society of Mechanical Engineers for five years and during that time representative of American Society for Steel Treating on that committee.

It will be seen that the action on the wire is an upsetting action and that if there is any slippage between the feed rolls and the wire, the number of coils produced for a given action of the machine is likely to vary. In coiling machines equipped with an automatic cutting attachment. any slippage between wire and feed rolls will result in a non-uniformity in the length of the finished springs. Fig. 1 shows a spring coiling machine equipped with automatic cutting attachment. By making the proper adjustments, this machine can be made to produce open or close coiled springs, straight, conical or barrel shape, and will close the end coils on open coiled springs. Spring coiling machines of this general type are perhaps the most widely used in the industry, since they will turn out a satisfactory quantity of springs hourly for most requirements and are flexible enough to take care of almost any type of compression or extension spring with little adjustment.

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WHERE springs are required to have special ends (ends other than the ordinary loops or hooks that can be turned up from a straight coil, or the plain or squared end of the ordinary compression spring) as in the case of most torsion springs, it is usually more economical to produce them in quantities upon a winding machine or torsion spring machine. These machines cut the wire to length and automatically wind it around an arbor. Such a machine is shown in Fig. 2.

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SPRINGS are often made in small quantities by winding around a mandril after attaching the end of the wire in the chuck or passing through a hole in the mandril.

This is the customary manner of making samples, but where close tolerances are to be met, it is sometimes found that springs produced upon an automatic coiling machine do not possess the same characteristics as springs of the same material and the same dimensions as those produced by hand in the aforementioned manner. When a spring is wound by hand about a mandril, the wire is in tension and there is a drawing tendency as contrasted with the upsetting tendency of the automatic coiling machine. In the case of extension springs of cold drawn or oil tempered wire, there is also likely to be a difference in initial tension between springs produced by hand winding and those produced upon the automatic coiler.

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IN the case of coiling springs as in other phases of their manufacture, the cost is dependent upon the tolerances within which specifications must be met. For this reason, it is necessary that the purchaser of springs know just what tolerance is permissable, if he is to obtain a product that will suit his needs satisfactorily at the lowest cost. When the spring manufacturer is forced to guess at permissable tolerances, his quotation may be too high, due to basing his estimate on tolerances, which are narrower than necessary, or too low, due to assuming he has more leeway than actually exists.

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LOAD-DEFLECTION tolerances are sometimes very important, and since, on a given solid length of coil, these will vary as the fifth power of the wire diameter, a very slight variation in wire diameter is likely to cause a change in the rate of the spring that definitely places it outside the specified load-deflection tolerances and would be ample cause for its rejection. The usual manner of making springs meet load-deflection tolerances, in spite of slight variation in wire diameter, is changing the coil

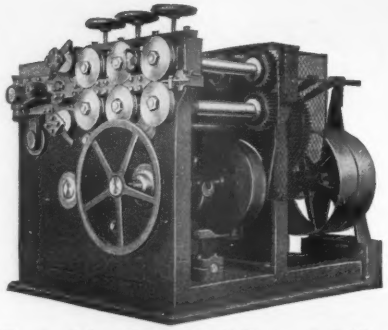

Fig. 1—Automatic Spring Coiling and Cutting Machine. Courtesy of Sleeper & Hartley, Inc.

diameter to compensate for such variation. The machine operator is furnished with a table showing the changes in outside coil diameter necessary to counteract changes in wire diameter by one ten thousandth of an inch. He then takes frequent measurements upon the diameter of the wire in two directions and adjusts his machine to give the corresponding correct outside diameter. This operation, in addition to requiring the constant attendance of an operator at the machine, cuts down the speed of production, and may increase the cost of coiling as much as 400% over that of ordinary commercial springs, depending upon the tolerances which must be met. Tolerances will also indicate, to a certain degree, what material must be used, since it is usually possible to obtain more uniform results with an annealed wire, heat treated after coiling than with a pretempered wire.

Fig. 2—Torsion Spring Winding Machine. Courtesy of Sleeper & Hartley, Inc.

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IN addition to the standard types of coiling and winding machines, a great many special machines are used. Such machines are made for one of two reasons, viz, either no standard machine can produce the required design, or the quantity of a single spring produced warrants the sacrifice of flexibility in the machine for the sake of increased hourly production, combining in a single machine, the operations usually performed by two or more machines or otherwise reducing the cost of manufacture. Fig. 3 shows a machine used for the production of rectangular springs such as used in the magazines of automatic pistols, and rifles.

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Heat Treatment of Springs

SPRINGS may be heat treated for any one of a number of reasons, depending upon the type of spring. In the case of large helical springs, it is necessary to heat the spring in order to coil it. In the case of some spiral instrument springs, it is necessary to subject the wire, constrained to a spiral form, to heat in order that it will retain its spiral shape after removal from the forming barrel. In the case of helical springs of tempered wire, a low temperature heat treatment is usually given after forming to relieve the internal strains produced by cold work and to increase the elastic limit of the material. In the case of helical springs formed of annealed wire, a heat treatment at high temperature, followed by an oil quench is necessary to give the material its spring properties. After this another heat treatment at a much lower temperature is given to produce the proper temper in the material.

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WHETHER the heat treatment given a spring consists simply of a low temperature draw to relieve internal

strains or the compound process required in the case of springs coiled of annealed wire, it is perhaps the most important of all phases of spring manufacture and must be carefully controlled. Numerous types of furnaces are successfully used in heat treatment of springs. They may be classified according to the type of fuel used as oil gas or electric (these being the most common), by the manner in which the charge is handled, as for example single charge or continuous furnaces, or by the atmosphere to which the charge is exposed, as semi-muffle or full muffle or oil, lead or salt bath. Whatever type of furnace is employed, it is important that the temperature and atmosphere be carefully controlled. These should be even in all parts of a single charge furnace so that all springs in the charge will obtain the same thermal treatment and must be capable of reproduction on later charges so that successive charges will exhibit the same qualities. In the case of continuous furnaces, the temperature in different parts of the furnace is usually made to show a difference, since the springs, being exposed to all parts of the furnace, will receive identical treatment regardless of temperature variation within the furnace itself.

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DURING the last thirty years, there has taken place a decided change in the manner of heat treating springs, and consequently a vast improvement in the quality of the finished product. Two factors of great importance in this change and the metallurgical microscope and the pyrometer. The former has permitted the spring maker to associate spring properrties with certain characteristics of grain structure in the material and the latter has enabled him to reproduce exactly furnace conditions. ✦ ✦ ✦

ATMOSPHERE, as well as temperature, is an important factor in the thermal treatment of springs. In the case of lead or salt baths, atmospheric control is usually a simple matter, in electric

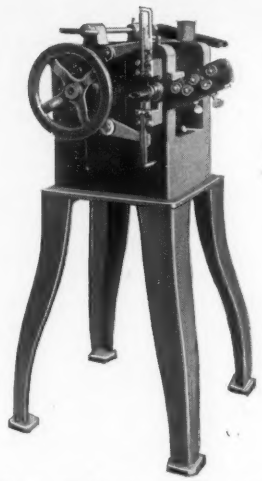

Fig. 3—Rectangular Spring Machine. Courtesy of Sleeper & Hartley, Inc. ✦ ✦

furnaces or in furnaces of the full muffle type, the control of furnace atmosphere offers little difficulty. When gas furnaces of the semi-muffle type are employed, it is necessary to make sure that the fuel is free from injurious impurities and of uniform analysis. Complete combustion of the gas is not sought but the mixture of gas and air is so controlled as to leave about 4% of carbon monoxide in the flue gas, sacrificing heating efficiency in order to obtain an atmosphere that is reducing. In this way oxidation of the springs' surface during their heat treatment is guarded against.

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WHEN springs are quenched, in large quantities, it is necessary to control the temperature of the quenching bath as well as that of the furnace, since wide temperature changes will not only affect the viscosity of the oil, but other properties upon which its quenching efficiency depends. This is accomplished either by coils of circulating cold water in the quenching bath or by circulating the quenching oil itself. Periodic checks for specific gravity and viscosity are made upon the quenching oil to assure uniformity.

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INDICATING pyrometers are used in the furnace room itself, and recording pyrometers are placed in the office of the factory superintendent. Every heat of springs is identified with its record as shown by the recording pyrometers, as well as with the lot of wire from which it was coiled. In this way the past history of any spring in the field can be traced all the way back to its point of origin, provided it can be identified as part of a known shipment from the plant of the spring manufacturer.

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Forming Spring Ends

MOST springs of the extension type are fitted with ends that are formed by turning up a full coil or half coil at the end, after coiling the spring upon a coiling machine, and before the spring is heat treated. Fig. 4 shows a machine which automatically cuts a spring to length fr.m a long coil and hooks the end. Special ends are formed usually by hand tools at the bench.

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IN the case of compression springs with squared and ground ends, the ends are squared upon the coiling machine and ground after heat treatment. The grinding may be accomplished upon a double disc grinder in which both ends of the springs are ground at once. A spring holder consisting of a steel frame with handle is ordinarily employed with such a grinder. This frame is filled with steel tubes of a length and diameter to accommodate the springs to be ground. The tubes are fastened firmly within the frame, which slides in a dove tail groove between the faces of the grinding discs. The movement of the grinding discs toward each

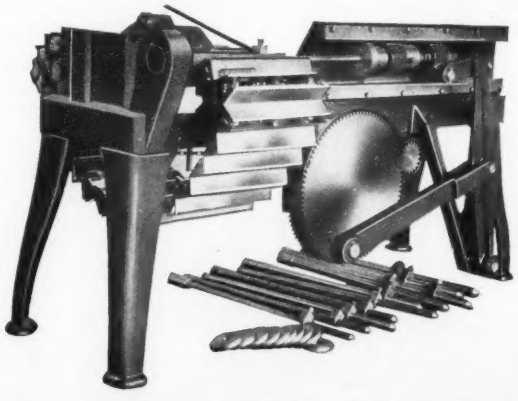

Fig. 4—Automatic Cutting and Hooking Machine. Courtesy of Sleeper & Hartley, Inc. ✦ ✦ ✦ ✦

other is limited by an adjustable stop, which is set according to the desired length of the finished spring. As many springs as the holder will accommodate are ground at one time. Other types of spring grinding machines are semi-automatic. In such machines, the spring to be ground is threaded onto an arbor by the operator. A rotating turret then carries the spring slowly across the face of the grinding wheel, after which it is automatically stripped from the arbor and ejected. The operator feeds one spring at a time, and there are ordinarily about twenty springs in contact with the grinding wheel at once, so that the grinding is continuous as compared with the intermittent operation of the double disc grinder.

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THE cost of end grinding, like the cost of other operations in spring manufacture, will depend to a large degree upon the tolerances which must be met. A specification which calls for a spring to be square within 2° may be met without difficulty in a spring having four coils to the inch and a ratio of coil diameter to wire diameter of less than five. When the coils to the inch run as high as fifteen or twenty and the ratio of coil diameter to wire diameter is as great as ten to fifteen, the same specification may be met only by exercising the greatest care and increasing the cost of manufacture.

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COMPRESSION springs are usually "set" solid after coiling and heat treating, after which operation their free length is usually slightly less than before. In subsequent operation the springs will then not take any further "set" and may be expected to return to their original free length after any degree of compression. This setting of compression springs may be accomplished by hand or by a machine such as that shown in Fig. 5. This machine is semi-automatic, the springs being fed by hand into receivers arranged in the form of a trough like chain, after which they are automatically, carried into position, "set" stripped and ejected. After the springs have been "set", a slight recovery takes place similar to that which takes place in spiral instrument springs, so that the free length of a compression spring may actually be greater by the time it reaches its destination than it was at the time of shipping from the factory. When free length tolerances are very close, this recovery becomes important, as it is possible that springs satisfactorily passing inspection at the factory will be rejected by the customer. This recovery may be accelerated by heating the springs for a short time at a temperature of 200° F. after which no further recovery may be expected to take place. Here again, the tolerance specifications may have an important bearing upon the cost of manufacture.

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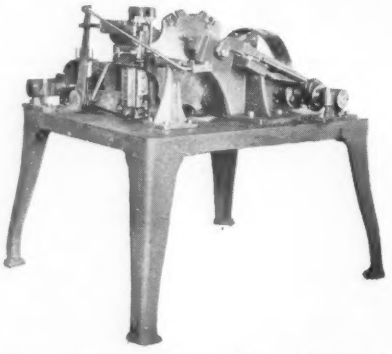

Fig. 5—Spring Setting Machine. Courtesy of Sleeper & Hartley, Inc. ✦ ✦ ✦

Spring Finishes

RECENT research in the field of corrosion fatigue has emphasized the importance of protecting the surface of springs against corrosion. The application of a coat of black japan has long been a customary finish for many types of springs, being fairly cheap and easily applied. A coating of neutral oil will often serve as a satisfactory corrosion deterrant, even when the springs are used out of doors, providing it is renewed occassionally. A metal plating such as nickel or cadmium is perhaps the best of all, but must be very carefully applied in order to avoid hydrogen absorption. and consequent embrittlement, at any stage of the process. Chemically applied finishes, such as phosphate coatings have been successfully applied to steel springs as a means of corrosion protection, but here, as in the case of electro-deposited coatings, care must be taken to avoid embrittlement. If springs are to be plated, they should be ordered with the desired finish from the spring manufacturer, as a good spring may be rendered useless by improper plating and the manufacturer of springs will seldom accept the responsibility for the performance of springs which have been plated after leaving the factory.

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IT will be appreciated from the foregoing that at practically every stage of manufacture, cost is largely dependent upon tolerances which must be met. By specifying tolerances which are closer than necessary the user of springs may increase needlessly the cost of his springs by more than one hundred percent. For this reason, it is important that the user of springs avail himself of the services offered by practically every large spring manufacturer and do it during the early stages of the design or manufacture of a new product. While it is frequently possible for the spring engineer to render valuable service after a manufactured item has already been put into production, it should be borne in mind that an ounce of precaution is worth a pound of cure and that a correction in the drafting room can be accomplished at infinitely less expense than a correction in dies or patterns.

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Development and Standardization of Types of Military Equipment

By Frank W. Bullock,
Captain, Signal Corps, U. S. Army

A paper presented before The Wire Association Meeting at Cleveland, Ohio, October, 1936, outlining what the arsenals and laboratories seek to accomplish and how they go about it together with experiences to demonstrate the importance of the work of these agencies. ✦ ✦ ✦ ✦ ✦

ABOUT three years ago it was my privilege to visit one of our manufacturing arsenals on the occasion of an 'open house' given in connection with the annual meeting of the American Society of Metals. During the tour of inspection of the plant and laboratories, a large prosperous appearing gentleman, expansive as to waistcoat, watch chain and fraternal society emblems, apparently mistaking me for somebody, instead of a mere Army officer, gave tongue something in this wise. "This is some plant if you ask me, but I'm a taxpayer, and I can't see what good it will ever do me. I like to see my money do something worthwhile, and about all this place does is provide soft jobs for a lot of brass buttoned lads who couldn't make a living if they had to work for it."

✦ ✦ ✦

MY first reaction was an almost uncontrollable urge to offer the gentleman a dime for his financial interest in the arsenal with the assurance that by accepting the offer he would realize at least 100% profit on his personal investment. But with the return of a measure of sanity came the thought that his idle remark reflected the opinion of a large and influential group of otherwise clear thinking American business men. And why not? Every manufacturer knows that in times of national danger it is he who must produce the material "sinews of war", but few have any conception of the assistance given him by the Government arsenals and laboratories in making possible the accomplishment of his task. The role of the arsenals and laboratories in preparing for war time production is a factory problem of the highest order.

IN the following report I shall attempt to do two things. First to convey some idea of what the arsenals and laboratories seek to accomplish and how they go about it. And second, by a few examples taken from the experience of the late war, show something of the importance of the work of these agencies when the always unexpected emergency comes. The report is offered neither as a defense nor as an apology. It contains no argument and suggests no conclusion—it only seeks to tell the story.

CAPT. F. W. BULLOCK
Signal Corps, U. S. Army. Member Wire Association

BY the provisions of the National Defense Act *(1) the military establishment of the United States is charged with a twofold responsibility, first to preserve peace with security, and second, to restore peace should it be forcibly violated. For the discharge of this responsibility but two resources exist, men and material, and the first or peace time function of the military establishment includes the duty of preparing plans calculated to make possible the prompt and effective use of these resources, if and when needed.

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THE effective use of the nation's resource of man power for defense is dependent upon our ability to provide men with, and train them in the use of, those material things without which they can neither fight nor survive. The people, by the enactment of law, have demanded positive assurance that this will be accomplished. To provide this assurance, the military establishment is associated with that complex social and economic fabric which we call industry, in a joint undertaking aimed at a common objective. Industry can fully accomplish its defense mission in war, only if the technical services of the military establishment fully execute their mission in peace.

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THAT portion of the peace time responsibility of the War Department which is strictly a factory problem is set forth in Section 123 of the National Defense Act.* (1).

"Sec. 123. Procurement of Gauges, Dies, Jigs, and so forth. Necessary for Manufacture of Arms, and so forth. The Secretary of War be, and he is hereby, authorized to prepare or cause to be prepared, to purchase or otherwise pro-

*(1) Act of June 3, 1916, amended by Act of June 4, 1920 (39-Stat-205).

cure, such gauges, dies, jigs, tools, fixtures and other special aids and appliances, including specifications and detailed drawings, as may be necessary for the immediate manufacture, by the Government and by private manufacturers, of arms, ammunition, and special equipment necessary to arm and equip the land forces likely to be required by the United States in time of war: Provided, That in the expenditure of any sums appropriated to carry out the purpose of this section the existing laws prescribing competition in the procurement of supplies by purchase shall not govern, whenever in the opinion of the Secretary of War such action will be for the best interest of the public service."

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AT the time of the passage of this act, arsenals were for the most part storage and repair depots, capable of manufacturing certain types of military equipment on a scale not even adequate to satisfy the requirements of our tiny peace time army. Laboratories, such as we now have, did not exist. At the same time, except for powder and industrial explosives there was nothing in the United States even approximating an experienced private munitions industry such as had existed in Europe for a thousand years. Today, eighteen years after the close of the Great War, the commercial, peace time manufacture of munitions by private industry in the United States, is of little or no strategic importance. To carry out the provisions of the statute, therefore certain limited public facilities have had to be created.

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THE authority vested in the Secretary of War by the Act quoted, did not in the beginning include any allotment of funds with which to make it effective. Consequently nearly a year subsequent to the passage of the Act passed before anything was undertaken. In March 1917, the first step toward the exercise of the above authority was made by the creation of the Munitions Standards Board. This board consisted of six representative manufacturers, serving without compensation, and invested with only advisory powers. They organized committees which included representatives of the uniformed services, to study certain essential finished products, such as artillery, ammunition, small arms, motor transportation, etc. These committees undertook to effect a standardization of gauges, to develop or modify existing specifications so as to bring about some degree of interchangeability of components to set up production and inspection procedures adaptable to commercial practices, to accelerate early production, and to assist manufacturers in adapting their plants to munitions production.

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BEFORE the board was a month old, our entry into the war made standardization as such, a minor objective. It was more important to procure than to plan how to procure. We had a war to win—or lose—and the Munitions Standards Board was submerged in the flood of greater undertakings.

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THE post-war reorganization of the War Department in compliance with the Act of June 4, 1920, included the formation of a War Department Technical Committee. The membership of this committee includes representatives of the Assistant Secretary of War, the War Department General Staff, and each of the Supply Arms and Services. It is the duty of this committee "to consider and make recommendations" relative to the determination of types of equipment to be used by the Army, and to "coordinate" the research and development work of the supply arms and services. The committee exercises no general supervisory authority but considers questions referred to it by the Chief of Staff. The determination of requirements for, and the selection of types of equipment is decentralized in the War Plans and Training Divisions of the Arms and Services under the supervision of the War Department General Staff. The actual development and initial production of selected types is conducted by the supply arms and services with the facilities and personnel provided for such work. It is the responsibility of the General Staff to coordinate the work of the supply services, prevent duplication and measure progress.

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FOR the purpose of establishing the status of articles of military equipment from the standpoint of development and suitability for service use, the following classification is applied:

a. Required types, consisting of:
- **(1) Development types, further classified as—**
  - **a. Experimental types.**
  - **b. Service test types.**
  - **c. Limited procurement types.**
- **(2) Adopted types, classified as—**
  - **a. Standard articles.**
  - **b. Substitute standard articles.**
  - **c. Limited standard articles.**

b. Obsolete types .

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SOME explanation of the significance of the above classifications is necessary for a clear understanding of discussion of procedure which follows.

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Required Type: This connotes an item of equipment for which there is a definite exxisting or anticipated military need.

Experimental Type: Refers to the initial appearance of the required type in concrete form.

Service Test Type: This title is applied to an item produced under tentative or performance specifications in quantities sufficient for limited issue for extended service or tactical tests.

Limited Procurement types comprise articles of equipment which have passed service tests favorably but are not ready for classification as an adopted type.

Standard: This represents the most satisfactory type of equipment fully developed, authorized for regular procurement, storage and issue.

Substitute Standard: This type represents an item comparable to a standard item, suitable for similar service and procurable if required.

Limited Standard: This classification refers to usable items of which there are stocks on hand suitable for issue until exhausted, but which will be replaced with a standard item.

Obsolete Type: Articles on hand which have been declared by competent authority to be unsuitable for further use.

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RELATIVE to the final adoption and classification of a type of equipment as "standard", certain general policies govern. The article must satisfy in operation or performance the specific military requirement for which it was designed. Designs must conform as far as practicable to commercial practices in order that procurement may be effected without undue cost or delay. The use of commercial components must include consideration of the protection of the rights of patentees, and bills of material must as far as practicable exclude all articles and material not of American growth or production. To insure compliance with

these general requirements, all new and changed specifications must be approved by the Assistant Secretary of War.

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PROCEEDING from this general picture, let us trace, step by step, the progress of the development of an imaginary item of equipment. First of all, it must not be supposed that a particular military need is in any sense hypothetical, on the contrary military needs are founded on experience. The art of war does not change, but the tools of warfare change constantly with the advance of civilization. No military scientist in the days when ballistae served as artillery, ever dreamed of the need of a range finder. The strategist of fifty years ago did not foresee that motor transportation would completely revolutionize the rates of maneuver and road distances, or that long range artillery and aircraft would create new tactics and technique for ground forces. In other words, each new device which comes into every day use, creates new military requirements.

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LET us assume then that the need for a new device has become apparent and that its general characteristics have been defined. Competent authority authorizes its development, and assigns it to the appropriate War Plans and Training Group for study and recommendation. After careful investigation and consultation with the interested arms and services the project is passed to the Research and Development Division of the supply service charged with its procurement, with the following information:

(1) Purpose of the device.
(2) Minimum performance requirements.
(3) Maximum allowable weight and volume.
(4) Tentative basis of issue (tactical units affected indicating probable mode of transportation, and quantities required.
(5) Article or articles to be displayed.
(6) If it represents an entirely new requirement, the articles already in service most closely related to it.

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IN the Research and Development Division, the new device is designated a "Required" type, given a tentative type and project number and assigned to the appropriate project officer whose duty it is to follow it through to its final adoption. Under the personal supervision of the project officer it goes to the Research Section, where by study and experiment, the technical characteristics of the device are worked out and carefully recorded in the form of Design instructions. It passes next to the design section where tentative working drawings and parts lists are prepared. Particular attention is given at this stage to the maximum utilization of "standard" components.

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FROM the design section, the project passes to the model shop where one or more units of the "Experimental" type are built. Complete manufacturing data, including nature and sequence of machine operations, materials used, and tentative time studies are in some instances recorded during the fabrication of the experimental units.

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COMPLETED models are returned to the research section where they are subjected to exhaustive tests, including endurance and transportation tests which are carried to destruction. Experimental types, particularly of Ordnance and communications material are tested by the supply service in its own testing facilities and rarely subjected to tactical or field tests. This provides for the proper safeguarding of secret devices and enables items which may be dangerous to be tested under proper safety conditions.

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THE recorded test data, together with the reports of the model shop are returned to the Design Section where tentative specifications and detailed and assembly drawings are prepared for the production of the "Service Test Type". Service test models are built either in the Government plant or by private manufacturers, whichever is deemed to best serve the public interest, in quantities sufficient to permit adequate tests under service conditions by tactical units. As in the case of experimental models, full and detailed production data are recorded, including in the case of extremely technical equipment, bills of material for an estimated economical minimum production order, preferred machine layout, labor requirements in terms of class and number, and an estimate of tooling up time required.

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SERVICE Test units when completed are carefully inspected and calibrated under the supervision of the project officer who prepared tentative operating instructions which accompany each unit sent out for tactical test.

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SERVICE tests are conducted under simulated war conditions and cover varying periods of time from a few days or weeks to the serviceable life of the equipment. Operating results are carefully recorded which, together with any recommendations for changes or improvements, are submitted to the branch technical committee of the using service for consideration and recommendation. The findings and recommendations of the board approved by the chief of the using arm, are forwarded through military channels to the supply service charged with the development.

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THE complete history of the development of the unit is then assembled in the office of the Chief of the supply service concerned and forwarded together with his comments and recommendations to G-4 of the War Department General Staff. G-4, after careful consideration, obtains the concurrence of all interested services in the adoption of the device, certifies that the item satisfies the military requirements and recommends its adoption as a "Standard type". Official notice of adoption is published to the service by the Adjutant General.

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THE next step in the life of the "Adopted Standard" item is the preparation of specifications and drawings in final form by the service charged with the procurement, storage and issue of the item. As in the earlier stages of develop-

ment this work is performed in the design section of the laboratory or arsenal. Working concurrently with the design section, the model shop prepares when appropriate, master gauges, patterns and where required, pilot models which serve as inspection standards.

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SPECIFICATIONS vary widely in degree of detail, but must conform to the forms prescribed by law. Where possible Army specifications must conform to certain basic specifications prepared by the Federal Specification Board, particularly with respect to raw materials and commercial components. Strictly military items are exempted from this requirement. For non-military items; for example subsistence items, fuel, lubricants, lumber, tools, etc., army specifications must be approved by the Federal Specification Board, and published as Federal Specifications applicable to all branches of the public service.

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WE are, however, considering an item of military equipment, the specification for which is subjected to substantially the following routine. Completed specifications, drawings, parts lists, instructions for inspection and testing procedure, gauge lists and bills of material, are forwarded from the Research and Development Division to the Supply Division of the office of the Chief of the procurement service. In the supply division of that office it goes first to the Storage and Issue section where it is assigned standard nomenclature, type number and master stock catalog class and item number. Drawings are checked against the specification index and all subsidiary specifications forming part of the complete specification are verified, and the specification forwarded to the Procurement Planning section of the same office.

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FROM the Procurement Planning Section, copies of the specification are sent out through branch procurement districts to representative manufacturers for comment and criticism. Manufacturers are requested to consider any features which might tend to cause unreasonable delay in getting into quantity production, and to suggest changes or modifications which they believe will facilitate production without detriment to the military value of the item. Two months is the normal time allowed for the examination of new specifications by manufacturers. All reports and correspondence are held confidential.

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WHEN reports are received from manufacturers the specification is submitted to the branch Procurement Committee which includes representatives of Research and Development, Supply, and Planning Divisions. This committee considers the comments of manufacturers and recommends approval, minor revision, or reconsideration by the technical committee. If approval is recommended, the specification is forwarded to the Planning Branch of the Office of the Assistant Secretary of War. In that office, the specification is considered by the appropriate commodity section, with particular attention to raw material requirements. If found satisfactory, the specification is approved by the Assistant Secretary of War, and returned to the preparing branch, which publishes, distributes and acts as custodian of the specification. Gauges, patterns, models, and other fixtures when prepared are held in depots or arsenals at the disposal of purchasing and contracting officers. From this point on the production of a standard item is controlled by the availability of appropriated funds.

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BUT, one may ask, is all this costly research and development work really important? Is it not a useless addition to our already burdensome armament costs? National defense, like medicine and surgery is partly preventative and partly curative. While seeking to preserve peace our army must prepare to restore peace quickly should it be lost. While cost is of primary importance when considered in relation to the preventative functions of armament, when the necessity for the restoration of peace arises, time becomes the all important consideration. Any expenditure which may effect a saving of time when war comes is more than justified when we remember that the loss of a single day or even an hour may cost thousands of human lives.

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THE manufacturing facilities of the Government are capable of satisfying barely 5% of our war time munitions requirements, for the other 95% we must rely on private industry. Much of the confusion and delay in our program of war production during the late war was the result of the lack of knowledge and experience in the production of noncommercial war materials on the part of private manufacturers. During the past ten years manufacturers have suggested that to assure early production of noncommercial items in war they should be afforded the opportunity in time of peace to make small quantities of munitions in order to train their personnel in war production. They contend rightly that the small group of engineers, inspectors, foremen and mechanics thus trained will be able to train rapidly the large working forces which must be recruited in time of war. The placement of such educational orders is not authorized by existing law. Lacking such authority the best that can be done is to continue the work of the Government facilities and maintain a nucleus of trained men.

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UNDER existing law, munitions must be manufactured in Government establishments unless they cannot be produced there satisfactorily. If produced in private plants, contracts must be awarded on the basis of competitive bidding. The Army assists such bidders by making available to them the results of its research and developments activities.

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DIES, gauges, jigs and tools are of vital importance in attaining mass production quickly. There are few precision instrument manufacturers in this country and the quantities of these items required

for a war production program cannot be produced overnight. Just how important these items are is suggested by the fact that a complete round of 75 mm shell requires 284 limit gauges, and a service rifle Cal. .30-06 requires over 500. Unfortunately little or no money has been appropriated during the post war years for the accumulation of a war reserve stock of these essential items. The best that can be done is to provide certain master tools to furnish contractors with standard patterns from which to make their own working gauges.

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THE story of munitions manufacture is a story of components. A relatively simple item such as 37 mm gun has no less than 2500 components while a really complicated item such as an anti-aircraft battery remote control set has approximately 8000 components. If emergency requirements are to be met, these components must be made in many separate plants. Carelessness in the production of even the least of them may mean death to the man on the firing line. If the work of our arsenals and laboratories assures us that these components will be properly made when needed it is worth whatever it costs.

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THE question naturally arises, how is the knowledge gained at so great a cost made available to manufacturers? Initial orders for war materials must necessarily be placed with plants whose personnel is unfamiliar with the processes of that particular type of manufacture and whose equipment was designed for widely different purposes. Personnel must be quickly instructed and plant layouts must be reorganized. To meet this situation the technical services are preparing descriptions of manufacture, sometimes erroneously called factory plans, in convenient book forms, to accompany the specifications, drawings and gauges pertaining to any order. These descriptions should, and in some instances do contain information of the following character:

A list of drawings and specifications.

A list of operations showing the machines used, the number of operators per machine, the ideal capacity of the machine, titles and drawing numbers of tools, gauges, jigs and fixtures.

A detailed description of operations with suggestions as to scheduling.

A description of contractor's inspection procedure.

A description of the Government's inspection and tests including a list of the instruments and equipment required.

A bill of material for 1000 units (100,000 in the case of small arms ammunition).

A shop layout designed to produce a certain number of units per 8-hour day.

A summary of machines required.

A summary of personnel by number and grades required.

The drawings of required fixtures, tools, gauges, etc., with certain important installation drawings.

In addition there would be furnished in time of war a list of preferred sources of contributory materials giving transportation distances, to assist in scheduling purchases.

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TO summarize, the work of the technical services of the Army leads up to one thing, namely to tell industry **what** we want. It remains for the procurement planning agencies to determine and inform industry as to **how much** we want and when, where and in what order we want it.

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HAVING thus enlarged upon the objectives sought in the work of Government arsenals and laboratories, and described in ultra simplified sequence the procedure by which such work is performed, let us go back for a brief survey of some of the events of 1917 and 1918. And let us ask ourselves this question: How many of the difficulties and delays which hampered our industrial war effort would have been preventable through adequate peace time research and planning?

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LEST one be accused of deliberately selecting "horrible examples", for our first 'sample' we will take a case which was successfully worked out, namely the production of service rifles. At the time of our entry into the war there were on hand approximately 600,000 serviceable Springfield rifles and 160,000 obsolete Krag-Jorgensen rifles and carbines. The Springfield rifle, model 1903, had been built in two government plants, Springfield Armory and the Rock Island Arsenal. Some years prior to 1917, inadequate appropriations had forced a complete suspension of production at Rock Island, and the Springfield Armory was reduced to little more than a repair shop. The force of workmen skilled in the manufacture of Springfield rifles had been largely disbanded and the emergency found us as usual, unprepared. Even under the most favorable conditions these two plants could turn out only a fraction of the initial war time requirements, to say nothing of providing reserves for the replacement of combat wastage. But no commercial plant had ever manufactured the Springfield rifle, there was no stock of patterns, gauges, tools or fixtures, and there was no nucleus of trained personnel. For the commercial plants to build up adequate equipment and train their men for the production of Springfields would require months or even years. The situation looked hopeless. It just so happened that three large concerns were making final deliveries on British contracts for the Lee-Enfield rifle, and beginning to look about for new business. These companies had tooled up their plants for the production of rifles on a huge scale, and had, at the expense of Great Britain, organized a highly efficient work force. Their combined capacities were capable of satisfying our total rifle requirements.

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THE question was, should we adopt the Enfield rifle, inferior to the Springfield and using different ammunition, in order to get production, or should we undertake to tool up for the Springfield and trust to providence to prevent the German army from ending the war before we could arm our citizen armies. The choice of either alternative would have probably been disastrous. The problem of ammunition supply forced a compromise decision. Standard Cal. .30-06 ammunition was being made commercially in quantities, and the Enfield rifle could be modified with only a slight delay to accommodate it. It was therefore decided to change the Enfield rifle, standardize certain of its parts, and utilize the productive equip-

ment available to get into immediate production. From the final approval of the standardized drawings of the modified Enfield rifle, (U. S. Magazine Rifle, Model 1917) on August 18, 1917, until Nov. 11, 1918, some 3,300,000 rifles were completed and shipped overseas, a triumph for American ingenuity. Could the necessity for such measures have been avoided? Certainly, by adequate peace time technical preparation.

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FIELD artillery presents a less cheerful picture. Uninformed as to policy and without funds for the procurement of artillery material, the Ordnance Department took immediate steps to utilize ten or twelve plants in this country which had already acquired experience in manufacturing British and Russian shell, for the production of 3-inch ammunition for our own use. Our standard 3-inch shell was a low capacity, base fused shell, unsuitable for stabilized warfare, in which the nose fused, high explosive shell was most effective. It was therefore decided to adopt the Russian type H. E. shell to supplement our standard shrapnel shell. By May 31, 1917, tentative orders were placed for the above types of ammunition.

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ON June 5, 1917, however, announcement was made that the American Expeditionary Forces would cooperate directly with the French, using the French 75 MM gun as our standard weapon. This decision nullified the early efforts of the Ordnance Department. New specifications and drawings had to be prepared, new contracts had to be negotiated, and manufacturers had to be trained to manufacture unfamiliar material. French specifications had to be adapted to American dimensions and manufacturing practices and new inspection procedures and tests had to be developed. Tooling up, and preparation of gauges consumed another five months after the completion of drawings and specifications. Not until December 1917 was it possible to start production. November 11, 1918 saw only three hundred 75 MM guns actually en route to France and 1,600,000 rounds of ammunition landed in France.

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SPECIFICATIONS for essential items of equipment cannot be improvised, and for many items there are no substitutes. The criticism is frequently heard that munitions standards are too high, that they hamper production, and that wider tolerances would result in faster production and better products. During the war hundreds of changes suggested by manufacturers were tried in the hope of such improvements, the results were for the most part quite the opposite.

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TO cite an example, a certain large corporation which had accepted a large order for impact detonating fuses, suggested a change in the percussion primer which they claimed would materially speed up production and improve the product. They produced voluminous test records to support their contention. Their suggestion was accepted by the Ordnance Department, but unfortunately, in quantity production, results were unsatisfactory. Thousands of fuses had to be rejected, much valuable time was lost, and ultimately they had to return to the original design. Again, adequate peace time preparation would have avoided this situation.

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MAJOR E. C. Coryell, Ordnance Department, in his "History of Steel Forging and Machining of Common Shell and Shrapnel", attributes most of the confusion and delay in war procurement to the inability of the procuring services to state positively what is wanted and insist on getting it. In support of his opinion he states that from January 14, to May 11, 1918, 358 changes were made in the specifications for common shell. Similarly, from January to July, 19 changes were made in the specifications for so simple an item as field telephone wire. In a period of three months, no less than 1100 changes were approved in the specifications for the Liberty Motor. That most of these changes were made at the request of manufacturers is immaterial, the cause is the same. We neither knew what we wanted nor how to make what we already had.

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THERE are of course innumerable items of equipment and supply required, for which commercial products are in every way satisfactory. To standardize such items would be an unwarranted expense as well as a futile gesture. Then, too, no war was ever fought to a finish with the same types of equipment as took the field at the start. Changes and improvements must be made with a minimum loss of time. Our arsenals and laboratories as now organized will do much to facilitate such necessary changes. With many items, the strategic situation will determine their character by influencing supplies of contributory material. The duration of the war, the freedom of the seas, the location of theaters of operations may all affect the composition and type of many items of supply. But there are a few essential items of armament which have no commercial equivalent, these cannot be improvised after war starts. Production of standard types must start at full speed. The loss of a day in getting into production may lose the war. The work of our arsenals and laboratories has but one objective, to make sure, to the limit of human endeavor, that such losses shall not occur.

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BUSINESS men, supposedly a realistic and hardheaded lot, are in reality decidedly mercurial. Having survived an emergency they are prone to forget what that survival cost. Sure, they say, we had a tough time during the war, but we saw it through, in fact we won it. True enough, but in the case of the late war, only after eighteen months of confusion, delay and danger, at a cost exceeding twenty billions of dollars and a hundred thousand lives. Is it worth that price to neglect those preparations which will perhaps prevent a similar experience?

Outstanding Personalities of the Wire Industry

Youngholm Elected Vice President Westinghouse Electric & Manufacturing Co.

DAVID S. Youngholm was elected vice president of the Westinghouse Electric & Manufacturing Company at the last meeting of the Board of Directors. He will make his headquarters in New York.

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MR. Youngholm joined the Westinghouse organization 27 years ago. His first position was in the engineering department of the Westinghouse Lamp Company after which he entered the sales department.

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IN 1934 he was placed in charge of production of the Westinghouse Lamp Company, making his headquarters at Bloomfield. A year later he became Assistant Manager of Sales. In 1927 he was made Assistant General Superintendent of the company and in 1930 became Assistant to Vice President, later Vice President of the same organization, the position he held until his election as Vice President of the Westinghouse Electric & Manufacturing Company.

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John W. White Appointed General Manager

EFFECTIVE November 1, John W. White, formerly Managing Director of the Cia. Westinghouse Electric Internacional, S. A., with headquarters at Buenos Aires, Argentine, was appointed General Manager of the Westinghouse Electric International Company.

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BORN at Indianapolis, Indiana, on January 6, 1889, Mr. White received his early education at Randolph-Macon where he pursued an academic course and later, while engaged with Westinghouse at its main works at East Pittsburgh, Pennsylvania, attended night courses at the Carnegie Institute of Technology. Mr. White entered the employ of the Westinghouse Company in 1905 and continued at

DAVID S. YOUNGHOLM
Vice President, Westinghouse Electric and Manufacturing Co.

the main works at East Pittsburgh until 1912.

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IN 1917, he filled the position of Manager of the Central Station and Transportation Divisions of the Detroit Office.

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HIS first connection with export was in 1918 when he was assigned to Cuba as Westinghouse Manager with headquarters at Havana. In 1925 he was made Managing Director of the then Westinghouse Company of Japan with his staff office at Tokio. In 1931 he was made Managing Director of the Westinghouse Company in the Argentine, which position he held until his present promotion.

MARTIN L. HOPKINS,
Asst. Mgr. of Sales, Bolt and Nut Division, Republic Steel Corp.

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Martin L. Hopkins, Asst. Mgr. of Sales, Bolt and Nut Division, Republic Steel Corp.

MARTIN L. HOPKINS has been promoted to the position of Assistant Manager of Sales of the Bolt and Nut Division of Republic Steel Corporation, according to an announcement by N. J. Clarke, Vice President in charge of sales. Frank P. McEwen will continue as the other Assistant in this division.

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IN 1890, he became associated with the Union Rolling Mill Co. which for many years operated the only bar mills in the Cleveland territory. During his association with that company he became its Secretary and was in that position when it was merged with The Upson Nut Co. and Bourne-Fuller Co. in 1920. He was later elected Secretary of the combined companies and retained that title until the formation of Republic Steel Corporation in 1930.

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IN recognition of his thorough knowledge of bolt and nut manufacture and his wide acquaintance in the steel and automotive industries, his activities with Republic have been centered chiefly on the sales of bolt and nut products.

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Grant Goodwin, District Manager, Lindberg Engineering Company

MR. GRANT GOODWIN, 503 Illinois Building, Indianapolis, Indiana, is now associated with the Lindberg Engineering Company as District Manager of the Indiana and southern Illinois territory. Mr. Goodwin was formerly metallurgist of the Muehlhausen Spring Company, and prior to that time was with the Allison Engineering Company and the Chicago Screw Company.

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Sept. 1936 and Sept. 1935
(In gross tons)

	Sept. 1936	Aug. 1936	Sept. 1935
Wire rods	1,541	2,533	2,200
Hoops, bands and strip steel	4,942	4,906	3,366
Plain black or galvanized iron or steel wire	3,935	3,264	2,548
Barbed wire and woven wire fencing	3,739	2,576	1,784
Woven wire screen cloth	117	65	73
Wire rope	352	151	307
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	280	444	298
Wire nails	642	431	830
Tacks	24	34	40
Other nails, including staples	168	212	190
Bolts, machine screws, nuts, rivets and washers	639	492	575
Total, these 11 classifications	16,379	15,108	12,211

Imports of Iron and Steel Wire Into the United States
(In gross tons)

Concrete reinforcement bars	178	1,012	494
Hollow bars and drill steel	253	196	177
Wire rods	1,607	1,722	1,495
Barbed wire	733	1,038	1,931
Round iron and steel wire	449	530	308
Telephone and telegraph wire	1	1	.....
Flat wire and strip steel	232	283	161
Wire rope and strand	182	171	190
Other wire	346	180	132
Hoops and bands	2,156	2,683	2,525
Nails, tacks and staples	1,440	1,818	2,237
Bolts, nuts and rivets	27	94	6
Total, these 12 classifications	7,604	9,728	9,656

Exports of Insulated Wire and Cable, September, 1936

	Foreign		To U. S. Possessions	
	Pounds	Dollars	Pounds	Dollars
Insulated iron or steel wire and cable	29,845	$ 18,763	590	$ 134
Rubber-covered wire	397,591	94,327	115,558	27,982
Copper weatherproof wire	178,758	34,123	114,698	17,924
Copper telephone cable	11,426	2,225	522	149
Other insulated copper wire	321,551	80,883	81,591	15,558
Nickel-chrome electric resistance wire	16,802	22,878	20	16
Total, these 6 classifications	955,973	$253,199	312,979	$61,763

SEPTEMBER shipments of iron and steel products (excluding scrap) from the United States to overseas markets at 78,436 gross tons were valued at $5,726,082 and fell short (17.8 per cent in quantity and 9.0 percent in value) of the totals reached in the previous month. When compared with September, 1935, a quantity gain of 11.2 percent was registered, together with a comfortable margin of increase (15.1 percent) from a value standpoint.

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EXPORTS during the first nine months of the current year substantially gained in practically all of the leading items, when compared with the corresponding period of 1935. The distribution was in most cases widespread. Tin plate and taggers' tin represented the chief individual product shipped from a tonnage standpoint, reaching the extremely high total of 171,250 tons (87,579 tons in 1935.) Next was black steel sheets, which amounted to an aggregate of 99,189 tons (76,574 tons) followed by heavy rails, 48,829 tons (35,137 tons), 'other plate', 46,373 tons (28,447 tons), galvanized steel sheets, 40,484 tons ((55,199 tons), and 'other steel bars', 36,545 tons (40,697 tons).

✦ ✦ ✦

Imports Slightly Higher

A SLIGHTLY higher level prevailed in the iron and steel import trade when it reached (excluding scrap) 51,061 tons valued at $2,208,830, thereby registering increases of 6.0 percent in quantity and 5.5 percent in value when compared with the totals for the previous month. Against the totals for September, 1935, respective gains of 21.8 percent and 39.4 percent were registered. Aggregate imports of iron and steel products within the finished and semi-finished group during the initial 9-month period of 1936 amounted to 390,536 tons valued at $15,965,716, totals substantially ahead (43 percent in quantity and 35.8 percent in value) of those for the corresponding period of 1935. From a tonnage standpoint, the chief products imported during this period were pig iron (137,607 tons), shapes (41,135 tons), spiegeleisen (30,807 tons), solid and hollow bars (28,889 tons), 'other pipe' (19,485 tons), and 'other hoops' (17,755 tons).

✦ ✦ ✦

Exports Again Decline

A REVIEW of the individual iron and steel items shipped to foreign destinations during September reveals that when compared with the August trade lower volumes were recorded in 34 classifications with increases registered in 29. By far the outstanding decline (9,584 tons) was that in heavy rail shipments, other decreases of moment being recorded in those of tin plate (5,748 tons), cast-iron pressure pipe and fittings (2,106 tons), 'other plate' (1,789 tons), and wire rods (922 tons). The most pronounced increase registered (3,084 tons) was that in black steel sheet exports, followed by those in fabricated structural shapes (1,130 tons), barbed wire (1,065 tons), cold-rolled strip (770 tons), plain shapes (748 tons), and galvanized wire (432 tons).

✦ ✦ ✦

Black Steel Sheets Leading Product in Trade

INCREASING to 10,199 tons, black steel sheets—in a widespread trade — represented the chief product exported within the finished and semi-finished group during September. Canada (3,220) was the principal market, followed by Soviet Russia (3,168), Mexico (1,115), the United Kingdom (441), and Italy (322). Next came tin plate (also finding many out-

lets) shipped to a total of 8,893 tons, and going chiefly to Mexico (1,145), Japan (991), the Netherlands (835), Brazil (756), and Chile (486). Plain shapes (5,973 tons) followed and found their principal markets in Canada (3,737), Cuba (937), the Philippine Islands (325), and Peru (246). Practically all of the skelp exported (5,781 tons) was purchased by Canada (5,516). 'Other plate' (4,951 tons) was the fifth product of importance, the bulk thereof going to Sweden (1,630), Canada (1,003), Cuba (401), Soviet Russia (390), Mexico (379), and Japan (305). Galvanized steel sheets (4,211 tons)—in a widespread trade—went mostly to the Philippine Islands (1,015), Cuba (934), Colombia (836), and Uruguay (311).

✦ ✦ ✦

Canada Again Leading Individual Outlet

CANADA continued in its role as the leading individual market when 21,913 tons were dispatched thereto, the outstanding items in this trade being skelp (5,516), plain shapes (3,737), black steel sheets (3,220), hot-rolled strip steel (1,775), and cold-rolled strip steel (1,387). Following was Mexico (6,588 tons) whose trade included chiefly tin plate (1,145), black steel sheets (1,115), unlined tanks (570), barbed wire (494), 'other plate' (379), and seamless casing and oil-line pipe (306). Then was Cuba (5,106 tons), the outstanding products in its trade being plain shapes (937), galvanized steel sheets (934), 'other plate' (401), tin plate (361), and 'other steel bars' (356). Russia's purchases (4,545 tons)—next in importance—were mostly of black steel sheets (3,168), 'other plate' (390), tin plate (355), cold-rolled strip steel (298), and hot-rolled strip steel (252). Next was China (3,911 tons) with heavy rails (1,758), and steel ingots (1,001) the outstanding items in its trade which also included tin plate (335), and car wheels and axles (239). The sixth market—the Philippine Islands—took 3,010 tons consisting mainly of galvanized steel sheets (1,015), 'other steel bars' (439), and plain shapes (325).

✦ ✦ ✦

Slight Gain in September Iron and Steel Imports

UNITED STATES' imports of iron and steel products during September were at a somewhat higher level than in the previous month. Aggregate receipts during the reviewed month at 51,061 gross tons valued at $2,208,830, increased 6.0 percent in quantity and 5.5 percent in value when compared with the August trade, and against the totals for September, 1935, respective gains of 21.8 percent and 39.4 percent were registered. An analysis of the individual iron and steel products moving in the import trade (from a tonnage standpoint) shows that—when compared with the previous month—September receipts were higher in 21 items, lower in 16, while in 1 product (iron slabs) no trade occurred in either month. In 1 other (telephone and telegraph wire) it

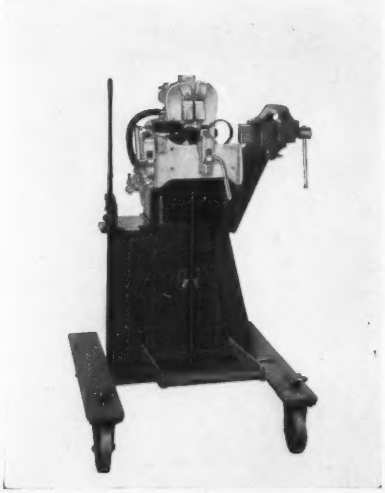
(*Please turn to page 724*)

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

CONTINUOUS IMPROVEMENT

MICRO-WELDERS with dial indicating annealing attachments are now available for high carbon wire.

There is positive control of annealing temperature and already hundreds of these special MICRO-WELDERS are proving their dependability and satisfactory performance with leading manufacturers.



MICRO PRODUCTS COMPANY
20 NORTH WACKER DRIVE, CHICAGO, ILL.
Telephone State 7468 General Office and Factory, Peoria, Ills.

A Review of Recent Wire Patents

No. 2,056,399, COATING PROCESS AND COATED ARTICLE, Patented October 6. 1936 by Carroll A. Hochwalt and Herman J. Reboult, Dayton, Ohio, assignors to The Mead Research Engineering Company, Dayton, Ohio, a corporation of Ohio.

More specifically, the method comprises providing an enamel coating by forming a spongy coating of zinc on the article and then applying the coating of enamel directly thereon.

✦ ✦ ✦

No. 2,056,688, WEATHER-TIGHT BOLT, Patented October 6, 1936 by August E. R. Peterka and Earl A. Eckhardt, Cleveland, Ohio, assignors to The Lamson & Sessions Company, Cleveland, Ohio, a corporation of Ohio.

It is claimed that this bolt will resist moisture creeping along the bolt from either direction, particularly the nut end, and the contruction is such that the bolt resists turning movement.

✦ ✦ ✦

No. 2,056,816, SPRING, Patented October 6, 1936 by Franz P. Zimmerli Detroit, Mich., assignor to The William D. Gibson Company, Chicago, Ill., a corporation of Illinois.

A spring of wire or rod is provided, the fibers of which vary in tensional strength from the outside to the center corresponding to the stress to which they are subjected when the spring is loaded, the outer fibers having the greatest tensional strength and the inner neutral fibers having the least tensional strength.

✦ ✦ ✦

No. 2,056,851, WIRE FABRIC WEAVING MACHINE, Patented October 6, 1936 by Noah S. Harter, Waukegan, Ill., assignor to Cyclone Fence Company, Waukegan, Ill., a corporation of Illinois.

A feature of this machine is devices to maintain the warp wire at their proper tension during weaving of the fabric.

✦ ✦ ✦

No. 2,057,562, ELECTRIC CABLE, Patented October 13, 1936 by Percy Dunsheath, Kent, England, assignor to W. T. Henley's Telegraph Works Company Limited, London, England, a British company.

This cable is of the type described in U. S. patent 2,052,922 dated September 1, 1936. Particular attention has been placed upon the spacing strip and adjacent portion of the cable in which the gas cushion is formed.

✦ ✦ ✦

No. 2,057,582, CONTINUOUS WIRE DRAWING AND ANNEALING, Patented October 13, 1936 by John R. McKean, Rumford, and Herbert S. Busey, East Providence, R. I., assignors to Kennecott Wire and Cable Company, a corporation of Rhode Island.

Instead of using external means for heating the annealing chamber, these inventors have devised a new arrangement, utilizing a flame obtained by the combustion of combustible material and an oxygen supply material, such as illuminating gas and air respectively, and providing an elongate annealing chamber, the wire to be annealed being conveyed through the flame in the direction of the length of the flame.

✦ ✦ ✦

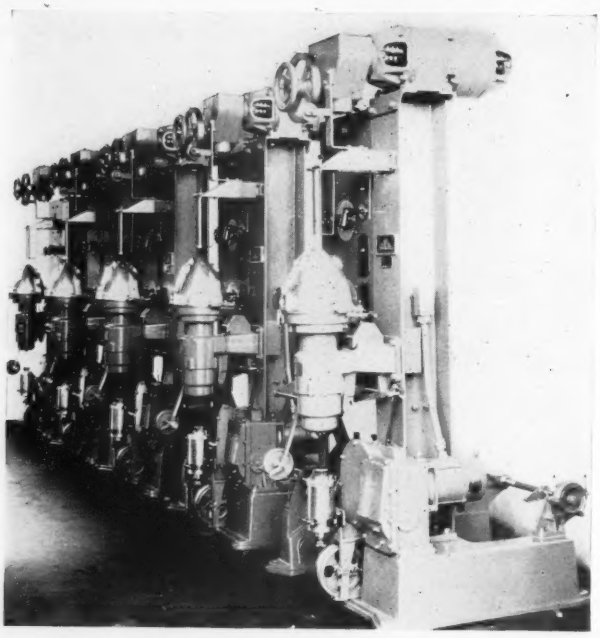
No. 2,057,688, ELECTRICAL CONDUCTOR, Patented October 20, 1936 by William Henry Moss, London, England, assignor to Celanese Corporation of America, a corporation of Delaware.

More particularly, the invention lies in the provision of an organic derivative of cellulose as fabric covering for the wire conductor saturated with the following:—polymerized acetate, diphenylol propane formaldehyde synthetic resin, tricreysyl phosphate, alcohol and acetone.

✦ ✦ ✦

No. 2,057,689, ELECTRICAL CONDUCTOR, Patented October 20, 1936 by William Henry Moss, London, England, assignor to Celanese Corporation of America, a corporation of Delaware.

The same saturant is employed in this patent is in No. 2,057,688 but the fabric surrounding the wire conductor is a knitted fabric.



SYNCRO insulating machines now operating at Take-Off speeds exceeding 200 feet per minute per unit.

"Syncro's" positive synchronous drive makes possible accurate and efficient spiral serving of both ribbon and fibrous materials on solid wires, stranded wires and cords.

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SYNCRO MACHINE COMPANY

187 SYLVAN AVE. NEWARK, N. J.

A Review of Recent Wire Patents

No. 2,057,690, ELECTRICAL CONDUCTOR, Patented October 20, 1936 by William Henry Moss, London, England, assignor to Celanese Corporation of America, a corporation of Delaware.

In this patent the material surrounding the wire conducter may be of any suitable material, the saturant being that described in patent 2,057,688.

✦ ✦ ✦

No. 2,057,806, APPARATUS FOR HANDLING WIRE, Patented October 20, 1936 by Frederick A. Whitehead, Glassport, and Frank L. Antisell, Pittsburgh, Pa., assignors to Copperweld Steel Company, Glassport, Pa., a corporation of Pennsylvania.

This apparatus is particularly adapted for handling high carbon or other hard wires, particularly for feeding such wire in the fabrication of wire products.

✦ ✦ ✦

No. 2,058,110, DRAWING DIE, patented October 20, 1936 by Karl Schroter, Berlin-Lichtenberg, and Hans Wolff, Gottingen, Germany, assignors, by mesne assignments, to General Electric Company, Schenectady, N. Y., a corporation of New York.

This drawing die is composed of a central portion consisting of a very hard metal alloy, preferably composed of about 93 per cent tungsten, 4 per cent carbon and 3 per cent cobalt, and at least one external layer situated on each front side of this central portion and consisting of an alloy of the same type as that of the central portion but of less hardness and greater thoughness, preferably an alloy comprising substantially 88 per cent tungsten, 6 per cent carbon and 6 per cent cobalt, the central portion including a central part of the drawing hole, while the external layers include the inlet and outlet parts thereof.

✦ ✦ ✦

No. 2,058,165, METHOD OF PROTECTING SILENCING, AND RIGIDIZING FABRICATED SPRING STRUCTURES, Patented October 20, 1936 by Charles F. McCoy, Pennington, N. J., assignor to Trenton Spring Products, Trenton, N. J., a corporation.

The method comprises coating the untempered wire spring structure at the point of connection of the several springs with unvulcanized rubber material and then heating whereby both tempering the spring and vulcanizing the rubber material is effected.

✦ ✦ ✦

No. 2,058,234, METHOD AND APPARATUS FOR COMBINING STRANDS, Patented October 20, 1936 by Vaughn L. Johannessen, Cranford, N. J., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

In this method, one group of wire conductors is stranded together spirally with a lay of a predetermined pitch, while another group of wire conductors is stranded with a lay of varying pitch.

✦ ✦ ✦

No. 2,058,462, SPRING MATTRESS ASSEMBLY, Patented October 27, 1936 by Charles D. Karr, Holland, Michigan.

A spring wire mattress assembly is provided comprising wire spiral springs arranged in rows the spirals of each row being connected by a chain formed of interlocked V-shaped links, the ends and the apex of each link being attached to an end turn of one of the spirals, such attachment of the link ends being on the central longitudinal line of the row of which the spiral is an element.

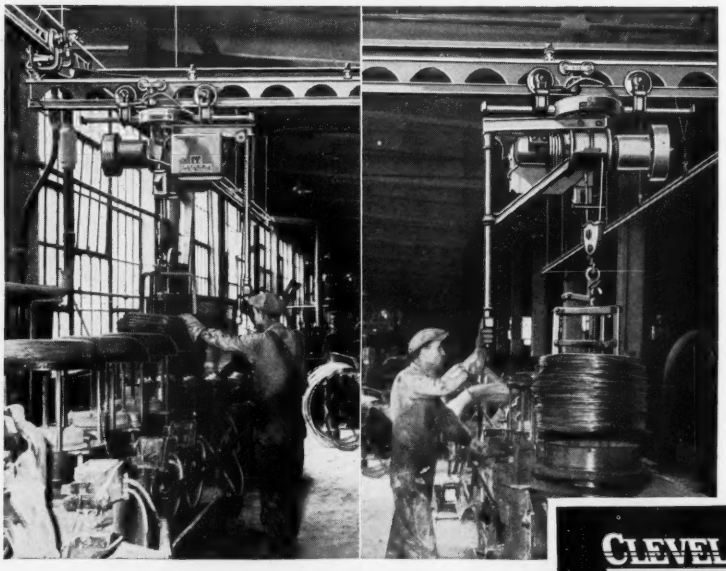
✦ ✦ ✦

No. 2,058,463, SPRING ASSEMBLY, Patented October 27, 1936 by Charles D. Karr, Holland, Mich.

In this construction, the arrangement is somewhat different from that in patent 2,058,462 for the wire springs which are arranged in rows are provided with a chain of V-shaped links having their ends interlocked, each link having its ends attached also to the terminal turn of one of the spirals and at diametrical-

(*Please turn to page 720*)

OVERHEAD MATERIALS HANDLING



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WICKLIFFE OHIO

A Review of Recent Wire Patents

(*Continued from page 719*)

ly opposite points, the apexes of adjacent links being oppositely directed and connected with the end of the terminal turn of a laterally adjacent spiral.

✦ ✦ ✦

No. 2,058,721, FIRE ALARM CABLE, Patented October 27, 1936 by Ide L. Robblee and Royal L. Baker, Southbridge, Mass.

This cable comprises two wires, one of which is rigid and has an insulating covering, the second wire comprising a tensioning wire that has an inherent resiliency and which is bent at intervals apart to provide alternate loop portions which are reversely extended with respect to each other and which portions have the insulated rigid wire threaded in alternate fashion therethrough to arrange the bends alternately on the opposite side of the rigid wire and to cause the loop and the connecting portions of the connecting wires to exert a constant pressure in opposite directions upon the rigid wire.

✦ ✦ ✦

No. 2,059,146, FLEXIBLE ELECTRIC CABLE, Patented October 27, 1936 by Frans Marius Roeterink, Eindhoven, Netherlands, assignor, by mesne assignments, to N. V. Philips Gloeilampenfabrieken, Eindhoven, Netherlands, a Dutch company.

More specifically a high voltage cable is provided which comprises a tubular body of yielding insulating material with a smooth inner surface and a conductive film in intimate contact with this surface and a flexible conducter having substantially the same potential as this film, the conducter also having portions readily movable axially with relation to the inner surface mentioned.

✦ ✦ ✦

No. 2,059,178, ELECTRIC CABLE, Patented October 27, 1936, by Rudolph A. Schatzel, Rome, N. Y., assignor to General Cable Corporation, New York, N. Y., a corporation of N. J.

This cable structure comprises the wire conducter with an insulating wall enclosing the conductor and a thin conducting layer completely enclosing the insulated conductor. An overlying layer of wire, then another thin conducting layer over the wire, each of the thin conducting layers contacting with the wires. Over all is a non-metallic sheath.

✦ ✦ ✦

Atlantic City Gets 1937 Wire Association Meeting

IN conformity with the practice of The Wire Association to hold its meeting coinciding with that of the National Metal Congress and Exposition, the 1937 Convention will be held October 18-22 with the exposition in the Municipal Auditorium, Atlantic City, New Jersey.

✦ ✦ ✦

THIS decision was made by the board of trustees of the American Society for Metals meeting, November 19-20, and has just been announced by W. H. Eisenman, secretary of the society and managing director of the show.

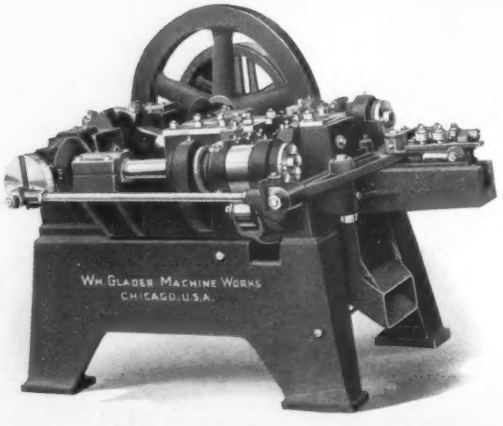
✦ ✦ ✦

THE policy of opening the show only to those actively interested in the production and use of metals, initiated at the Cleveland show this year and meeting with much favor will be continued in 1937.

✦ ✦ ✦

THE adequate hotel facilities and splendid exhibit space offered by the Municipal Auditorium were the basic reasons for the selection of Atlantic City. This is the first time it has gone to this city and it is believed that a very heavy attendance will result.

HIGH SPEED WIRE NAIL MACHINE



WM. GLADER MACHINE WORKS

210 N. Racine Ave., Chicago, Illinois

The production figures shown below are guaranteed, but without exception they are exceeded in general mill practice.

SIZE MACH.	SIZE WIRE	MAX. LENGTH OF NAIL	NUMBER OF NAILS PER MIN.	CAP. IN POUNDS PER HR.
#00	#14	1¼"	550	55
#0	#12	1¾"	450	89
#1	#10	2½"	400	192
#2	#8	3½"	325	310
#3	#4	5"	225	523
#4	#1	7"	190	622
#4s	5/16"	9"	175	1155
#5	3/8"	12"	160	2400

This high output and economical operation account for the GLADER machine being accepted as standard equipment in all recent installations.

'Round the World With the Wire Industry

Formation of Czechoslovak Furniture Spring Cartel

PRODUCTION, prices and sales of furniture springs and wire for furniture springs are regulated by a recently established cartel agreement in **Czechoslovakia** which is to remain in force until December 31, 1945, according to information from Assistant Trade Commissioner Jule B. Smith, Prague. Operations of the new cartel are controlled by the Central Office of Czechoslovak Wire and Wire Nail Manufacturers in Prague.

✦ ✦ ✦

Australian Producers Extend Activities at Port Kembla

AN agreement by which the Government is to sell 1,600 acres of land at Port Kembla to the **Australian** Iron and Steel, Ltd., was reported in the Iron and Steel Fortnightly No. 138. The company had agreed to spend £1,000,000 within the next five years on plants and equipment on the site in question. Trade Commissioner in Charge E. C. Squire, Sydney, reports further that actually it is proposed to spend double that sum within three years. The company named, together with the Broken Hill Proprietary, Ltd., will undertake the production of pig iron, galvanized iron sheets, tin plate, tin containers, wire netting, iron nails, motor bodies and other steel products. Some of those items have already been manufactured successfully by the aforenamed concerns and their subsidiaries—others such as tin plate and motor bodies will be important new developments. Lysaght's Newcastle Works, Ltd., (an allied company of the broken Hill Co. Pty.) last April commenced the manufacture of galvanized iron at temporary works at Port Kembla. It is now proposed to erect new works at Port Kembla to accommodate a plant twice the size of the existing one now employing 240 men.

✦ ✦ ✦

Wire Rope to be Produced in Finland

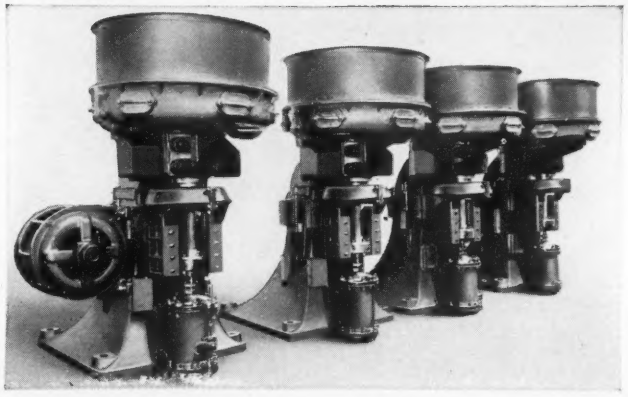
FORMATION in Helsingfors, **Finland** of Teraskoysi O. Y. for the purpose of manufacturing wire rope is reported by Consul George Orr of that city. Previously, all wire rope used in the country has been imported, and the new factory will (at least in its initial operation) use foreign raw materials, it is stated. Imports of wire rope in 1935 totaled 664 tons valued at 6,270,280 marks and came from Germany, Sweden, United Kingdom, and Norway.

Japanese Iron Nail Wire Undersells German Product

INFORMATION has been received to the effect that recently Japanese wire nail wire has been underselling German products of that character by 20 percent in Brazilian markets. On the other hand, German prices are said to be about 20 percent below American quotations.

(*Please turn to page 722*)

FARREL ROD COILERS



for rounds or flats

Farrel Rod Coilers are built in two types—the plate lifting type for round rods and the retracting pin type for flat or rectangular sections.

Both types have modern features of design and construction which assure dependable, efficient operation, with minimum maintenance.

- All moving parts are enclosed for safety.
- Silent chain drive and cut bevel gears are fully enclosed and run in oil.
- All shafts are mounted in anti-friction bearings.
- Bearings are lubricated by Alemite fittings grouped in a single block on the front of the machine, with leads to each bearing.
- Variable speed motor is mounted on adjustable bracket attached to base of machine to provide adjustment for chain drive.
- Plate lifting or pin retracting mechanisms are operated by air.

We are prepared to furnish individual coilers or complete coiler installations with centralized control desk, unloading mechanisms, conveyors, etc. For further information please address

FARREL-BIRMINGHAM Company, Inc.

38 Main St., Ansonia, Conn — 327 Vulcan St., Buffalo, N. Y.

'Round the World With the Wire Industry

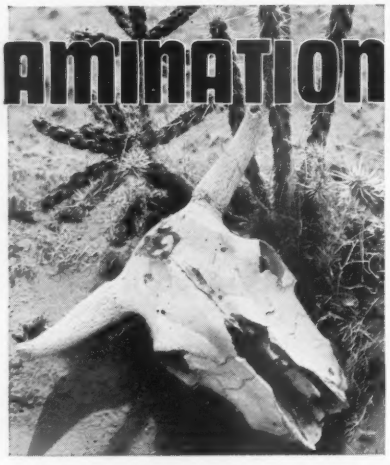
(*Continued from page 721*)

German Notes

THE wire rod export trade, which for a long time has been patchy, is reviving. The wire rod cartel has found it possible to advance quotations for many markets, for example to Japan to £ 5.5. (gold) and to China 5.10 (gold) per ton both c. i. f. Both of these markets are buying at the higher prices, and their markets are also buying more, particularly Sweden and the Balkans. Prices for Switzerland, Greece and Holland rose in their own currencies 42%. There is no wire rod industry in these countries and, therefore, the manufacturers there will have to pay higher prices in gold than before the devaluation. This will bear heavily on the competitive power of the manufacturers there.

Avoid CONTAMINATION

with **ACE HARD RUBBER**



Most contamination of solutions is directly traceable to improper equipment in transporting, handling or storing liquid chemicals. The terrific losses are therefore largely avoidable . . . avoidable through the use of Ace Hard Rubber or Ace Rubber protected equipment.

The Chemical Service Division of the American Hard Rubber Company is available to you as a consultant with the sole objective of improving handling conditions of both acids and alkalies in your plant. Its services are free . . . yours for the asking. Write your request today for a representative to call.

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PREVENTS CORROSION

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Please send me a complimentary copy of "ACE Hard Rubber Protection."
*Name*_____
*Firm*_____
*Address*_____ W. W. P.

THE general demand is satisfactory in the wire export markets. Brazil, China, Argentina, South Africa and other markets have bought well and the American demand is rising too for barbed wire, although last year's turn over figures have not yet been reached. Prices are firm despite the circumstances that a small Belgian outsider has started competition. The average selling prices for wire products are now approximately 7/6 shillings per ton better than early this year. The fact that the IWECO has been definitely extended for five years to 1941, including the wire netting manufacturers, has disappointed the speculators, who believed in a collapse of the cartel. On the bolt and nut export market, the international competition continues to be very keen despite the recent establishment of the French central office of the bolt industry and the union of Belgian bolt and nut manufacturers.

✦ ✦ ✦

THE quantity of wire nails and other wire products shipped for export in containers is constantly growing in importance. Certain Overseas markets are buying more than 15% of the total imports from Germany in containers.

✦ ✦ ✦

THE demand for high tensile strength wire, music wire and other specialty wire products on the export market is unusually heavy. The export figures for these products used for the manufacturing of springs, motor cars, aircraft and other products, is exceeding the demand during 1926-1928. Prices have been moderately advanced. These products are not subjected yet to the control of the IWECO and prices are widely different, but it is possible that in some way an agreement may be reached concerning sales of special steel wire and products.

✦ ✦ ✦

SINGLE strand barbed wire, despite many advantages (lower prices per length of the reel) is

slowly penetrating the export markets. It is produced chiefly in Switzerland and Germany. It is not produced in other European countries or only in small quantities. It is possible that the makers of this product will try to expand sales by an actively conducted advertising campaign.

✦ ✦ ✦

Lower Output of Ferro-Alloys in Canada

FERRO-ALLOY output in **Canada** during August at 9,290 tons, compared with 10,962 tons in the previous month and 3,893 tons in the corresponding one of last year, according to the Dominion Bureau of Statistics, Mining, Metalurgical and Chemical Branch, Ottawa. The bulk of the production was spiegeleisen, and the balance ferro-silicon.

✦ ✦ ✦

Nail Factory to be Established in Dominican Republic

A NAIL factory is to be established at Ciudad Trujillo, **Dominican Republic.** It is said that the firm will produce both wire and cut nails, but it is pointed out that the demand is chiefly for wire nails of most sizes, for practically all purposes. It is understood that the technical questions involved in connection with the establishment of the factory has not, as yet, been settled. Some equipment has been expected both from Germany and the United States. The concern in question intends to import wire, iron sheets or plates, and later the copper or brass materials, which will be needed in the manufacture of nails, tacks, staples and rivets, and because of its close proximity prospects for American suppliers in this connection appear very favorable, if prices and terms quoted are competitive. It is hoped to have the new factory installed and ready for operation by Nov. 1st.

✦ ✦ ✦

IMPORTS of nails and tacks (other than horse shoe nails) amounted to 750,529 · kilograms (valued at $53,881) in 1934, and in the following year the total was 766,489 kilograms (valued at $50,-370). The chief suppliers were the United States and Germany.

FURNACES FOR HEAT TREATING WIRE

SC GAS FIRED

Patenting Furnaces

Keeping pace with the wire industry in development of patenting, spheroidizing, hardening and galvanizing furnaces, SC Engineers have made possible much closer control of physical properties than has been possible heretofore. Increased production has been obtained along with improved physical properties, dependable uniformity and a cleaner surface of the product.

Surface Combustion DX GAS Preparation Units provide atmospheres for bright annealing, clean hardening, deoxidizing, normalizing and tempering, and may be used with existing furnace equipment by providing the proper muffle for the work. Ask SC Engineers in to talk over your heat treating problems.

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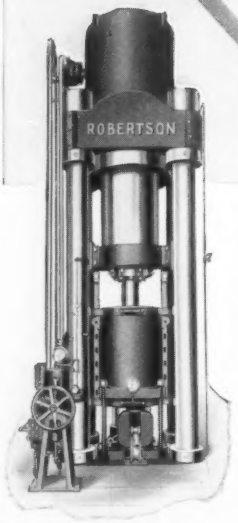

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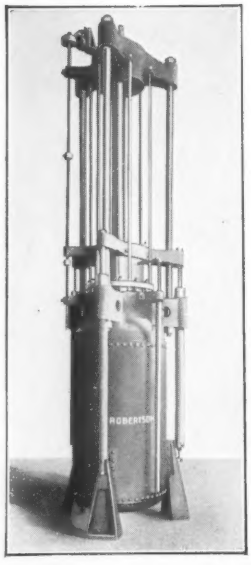

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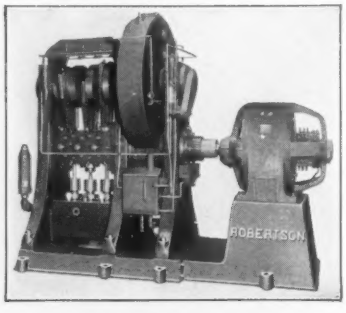

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Exports and Imports of Wire

(*Continued from page 717*)

remained constant. The outstanding increase (2,556 tons) was registered in pig iron receipts, followed by those in 'other pipe' (2,120 tons), sheets, skelp and sawplate (1,057 tons), ferro-manganese (836 tons), rails and track material (748 tons), and solid and hollow bars (680 tons). Lower volumes were received in shapes (2,053 tons), spiegeleisen (1,076 tons), concrete reinforcement bars (834 tons), 'other hoops and bands' (487 tons), nails, tacks and staples (378 tons), and barbed wire 305 tons).

✦ ✦ ✦

Pig Iron Again Leading Product Received

PIG iron continued to be the outstanding iron and steel product imported during the reviewed month, the total (15,080 tons) coming mostly from British India (5,687), Soviet Russia (4,585), and the Netherlands (4,053). Next was 'other pipe' (5,504 tons) for the most part received from Germany (4,426), and France (457). Structural shapes—next in importance—(5,211 tons) were chiefly supplied by Belgium (4,231), and France (937). Following came solid or hollow bars (4,237 tons) of which the bulk was received from Belgium (2,578), France (564), and Sweden (507). Spiegeleisen (4,173 tons) was the fifth product in the trade, Canada (3,173), and Soviet Russia (1,000) leading in the supply thereof. Sheets, skelp, and sawplate (3,119 tons) came principally from Germany (1,818), and Belgium (1,108).

✦ ✦ ✦

Belgium Leading Supplier in September

IMPORTS of semi-finished iron and steel products from Belgium during September aggregated 11,418 tons and were mostly of shapes (4,231), solid and hollow bars (2,587), 'other hoops' (1,772), and sheets, skelp, and sawplate (1,108). The next supplier of importance was Germany (9,835 tons) which sent in primarily 'other pipe' (4,426), sheets, skelp, and sawplate (1,818), nails, tacks, and staples (1,118), and welded

pipe (576). British India's participation—5,678 tons—was entirely of pig iron. Soviet Russia followed with a trade aggregating 5,585 tons, in which pig iron (4,585), and ferromanganese (1,000) were the chief items. Following came the Netherlands (5,046 tons) whose trade consisted mostly of pig iron (4,053), ferromanganese (641), and barbed wire (311). Canada was the sixth supplier of importance with sales totaling 4,257 tons in which the outstanding products were spiegeleisen (3,173), rails and track material (808), and pig iron (201).

✦ ✦ ✦

CARD clothing receipts followed an upward movement to reach 33,952 square feet valued at $40,679 and registered increases of 54.5 percent in quantity and 32.6 percent in value when compared with this trade in August. The trade during the reviewed month was covered by the United Kingdom (28,325 square feet valued at $34,674), Belgium (4,752 square feet and $4,111), and Germany (875 square feet valued at $1,894.)

✦ ✦ ✦

WIRE cloth and screening imports at 71,959 square feet compared with 70,520 square feet in August, and came from Germany (43,867 square feet), the Netherlands (9,179 square feet), Canada (8,890 square feet), and Czechoslovakia (1,023 square feet).

✦ ✦ ✦

WIRE heddle receipts amounted to 852,000 pieces against 478,000 pieces in the previous month, the suppliers being Germany (842,000) and France (10,000).

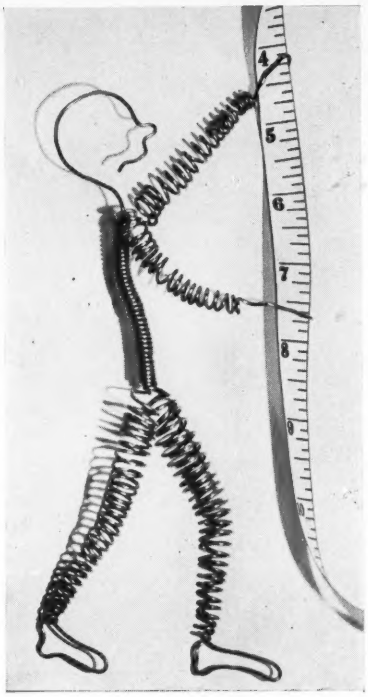
✦ ✦ ✦

FOURDRINIER and other papermaking wire receipts aggregated 30,096 square feet, a considerable decline from the 59,206 square feet which came in during August. Germany (17,755 square feet), Austria (8,539 square feet), and Switzerland (3,802 square feet) were the suppliers.

✦ ✦ ✦

NO trade whatever occurred in the galvanized before weaving grade of **wire fencing and netting**, against a trade of 134,675 square feet in August. Of the galvanized after weaving grade, receipts ag-

(*Please Turn to Page 731*)



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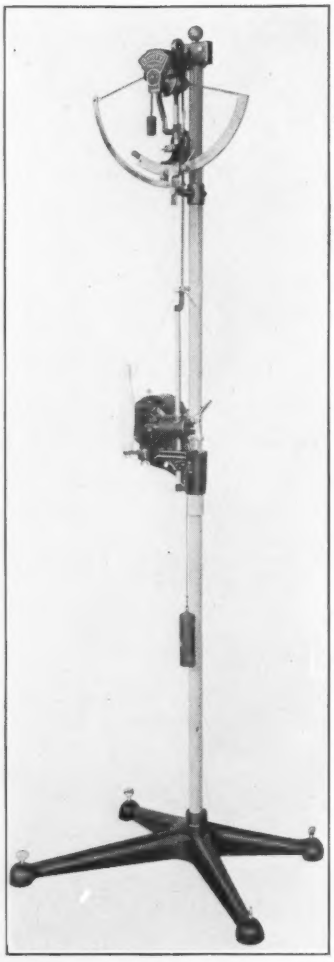

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Twentieth Anniversary of A. S. T. M. Atmospheric Corrosion Tests on Wire, Strand and Chain Link Fence

THE Twentieth Anniversary of the A. S. T. M. Atmospheric Corrosion Tests on black iron and steel sheets which were exposed at Annapolis, Md., in 1916, was celebrated on Friday, October 16. Since the specimens were put on the test racks, they have been faithfully inspected twice a year by a special subcommittee of the A. S. T. M. Committee A-5 on Corrosion of Iron and Steel.

✦ ✦ ✦

THE original series of tests started in 1916 included identical sets of test specimens exposed to the industrial atmosphere of Pittsburgh, the rural and light industrial atmosphere at Fort Sheridan, Ill., and sea-coast type of atmosphere at Annapolis. About 485 specimens of No. 22 and No. 16 gage sheets were exposed at each location. The Pittsburgh tests extended over a period of six years and three months during which a large number of failures developed in the specimens. The Fort Sheridan tests covered a period of eleven years in which 127 of the 219 specimens of No. 22 gage failed and four of the 216 No. 16 gage specimens. At Annapolis there have been no failures reported on the No. 16 gage specimens, but about 60 of the No. 22-gage have failed.

✦ ✦ ✦

THE chief feature of the selection of the specimens used in the tests was that some of the samples contained added copper and a comparable number were non-copper-bearing or had low-copper content. The experiments demonstrated quite conclusively that steel sheets containing up to about two tenths per cent. copper offer a distinct increase to resistance to atmospheric corrosion as compared with sheets with little or no copper when they are both exposed freely to the atmosphere.

✦ ✦ ✦

AS a result of information developed in these tests, various American industries have benefited greatly from the use of the so-

called copper-bearing steel. For instance, in the railroad field the life of the plate parts of hopper cars in normal service has been increased four to five years by the use of copper-bearing steel instead of the ordinary steel.

✦ ✦ ✦

THESE atmospheric experiments have shown the value of phosphorus as an alloying element, although this observation has not been so widely circulated as was the information on copper. Phosphorus and copper together in steel produce more resistance to atmospheric corrosion than does copper alone. Phosphorus in steel was always regarded as harmful, and something to be avoided with great care.

✦ ✦ ✦

NOT only did these experiments shed light on the efficacy of small additions of copper to steels, but they undoubtedly stimulated research into the use of higher percentages of copper as an alloying element. Within the past two years a number of so-called high-strength steels have been introduced in the market containing appreciable amounts of both copper and phosphorus.

✦ ✦ ✦

WHEN the atmospheric corrosion tests on black iron and steel sheets were inaugurated, they were the sole responsibility of Committee A-5, but several extensive research projects were subsequently initiated and a number of extremely important investigations are now under way. One series of tests involved the resistance to corrosion of black iron and steel sheets in running water in which 900 samples were exposed to filtered drinking water, brackish water and acid-mine water. Six hundred specimens of sheets were tested in a program to determine the resistance to corrosion in seawater. In another program 550 specimens of zinc-coated iron and steel sheets were exposed at each of five committee test sites, to various types of atmosphere, and in an extremely extensive test investigation began in January, 1929, 700 hardware specimens

(*Please turn to page 728*)

ES

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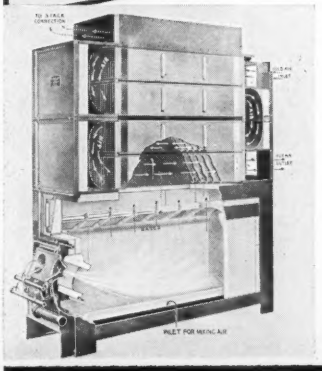

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NORTON ABRASIVES

A. S. T. M. Corrosion Tests

(*Continued from page 727*)

carrying commercial metal protective coatings of zinc applied by various processes, — cadmium, aluminum, lead, etc., — have been exposed at each of the five test locations.

✦ ✦ ✦

THE latest test program and one which is among the most extensive of those sponsored by the Society includes atmospheric corrosion tests of wire and wire products. In these tests involving plain unfabricated wire, barbed wire, strand, farm fence and chain-link fence, over 30,000 test specimens are being exposed at eleven test sites in widely separated parts of the United States. The specimens for these tests are now being assembled on the test racks.

✦ ✦ ✦

COMPLETE data and information on the various test programs sponsored by the Society's Committee A-5 have been published in the various Society publications.

✦ ✦ ✦

Preparation of Metal Surfaces

A MANUAL giving in detail methods for the application of sodium cyanide solutions in the preparation of metal surfaces is announced by The R. & H. Chemicals Department, E. I. du Pont de Nemours & Company. The manual gives a general outline for the various methods used in treating metal surfaces with specific information regarding the use and handling of sodium cyanide in that field.

✦ ✦ ✦

THE preparation of metal surfaces is discussed under the following general headings: Steel finishes, metal surfaces, direct application of sodium cyanide, cleaning ferrous metal surfaces, preparation of hot rolled steel surfaces, cleaning non-ferrous metal surfaces, preparation of steel surfaces for enameling, preparing metal surfaces, and safe handling of sodium cyanide.

Association Non-Ferrous Section Now to be Organized

AS a result of the recent meeting held at Cleveland at which there were over sixty members of the Non-Ferrous Section present, it was decided to go ahead with plans to conduct activities along this line during the year to a greater degree than heretofore. To effectuate this, the non-ferrous members of the Association will now organize themselves into the Non-Ferrous Division under the chairmanship of E. W. Clark, Mechanical Engineer, Wire & Cable Section of the General Electric Company, Schenectady, N. Y.

✦ ✦ ✦

THE division will cover

1—Metallurgy and research
2—Processes and methods of manufacture
3—Finishing of products, including braiding, covering, stranding, forming, fabricating and insulating.

✦ ✦ ✦

DURING the year papers will be presented through the medium of WIRE AND WIRE PRODUCTS relating to the various subjects covered by this section and at the annual meeting in 1937 there will be three sessions divided as heretofore noted under the subjects covered.

✦ ✦ ✦

THE activities of the organization will not in any way conflict with those of the National Electrical Manufacturers Association, known as NEMA, as The Wire Association activities are entirely devoted to processes of production.

✦ ✦ ✦

DURING the year the same question and answer method of handling technical problems for members will be handled as heretofore and it is hoped that many members of the Association will avail themselves of this service.

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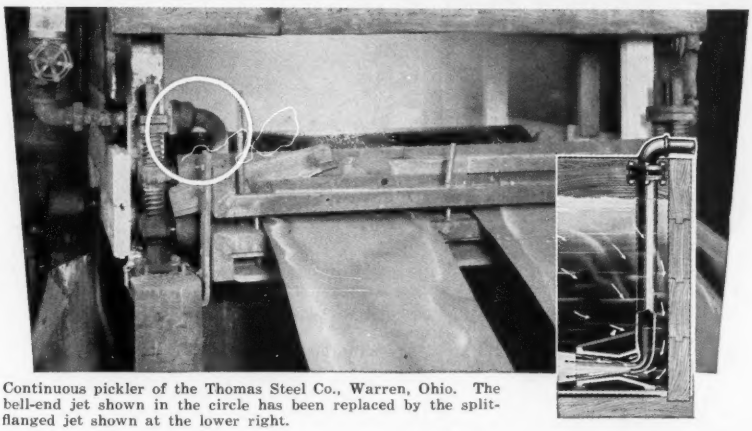

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A Review of Papers Presented at the Fall Meeting of the British Institute of Metals

"The Conductivity of Super-Purity Aluminum: The Influence of Small Metallic Additions" by G. G. Gauthier.

✦ ✦ ✦

THIS paper deals with the effect on the conductivity of super-purity aluminium (exceeding 99.99 per cent.) of additions of those elements which may occur as impurities in commercial aluminium.

✦ ✦ ✦

IT is shown that aluminium follows the universal law that the conductivity and the temperature coefficient of conductivity both increase with the purity: Mathiessen's law has been confirmed. The data presented in this paper on the effect of small additions on the conductivity of aluminium are of value in that they have been determined under favourable experimental conditions, owing to the extreme purity of the basis metal and the large amount which has been available. This high purity has made it possible to determine, with a stated accuracy, the effect of each one of the added elements in the almost complete absence of other impurities. Further, the figures given for iron and silicon, for these elements with titanium and vanadium, and for magnesium and silicon, make it possible to calculate the conductivity of aluminium of accurately known purity.

✦ ✦ ✦

NORBURY'S law does not appear to hold in the case of aluminium.

✦ ✦ ✦

"The Complex Interdependence of the Properties of Alloys and the Industrial Conditions of their Manufacture, Testing, and Use" by Marquis R. De Fleury and H. Portier, Dr.-Ing.

✦ ✦ ✦

A STUDY of indirect factors affecting the quality of foundry castings, examination of their reciprocal action and of the importance of their recognition in obtaining sound castings.

✦ ✦ ✦

UTILIZATION of scrap in the foundry, lowering of the quality of alloys by successive remelting; the use of organized production; control of raw materials; influence of the process of solidi-

fication of alloys and of the factors of moulding and casting; influence of design of castings and their size. Considerations regarding thermal treatment, modulus of elasticity of alloys, thermo-dynamic conditions, and the length of service.

✦ ✦ ✦

"Mechanical Properties of Aluminium and Its Alloys after Prolonged Heating" by Professor A. von Zeerleder, Dr.-Ing. and R. Irmann, Dr.-Ing., Met. Eng.

✦ ✦ ✦

THE strength of pure aluminium and various aluminium alloys has been investigated after heating for long periods at 75°-300° C. The strength properties of the same materials were determined also in the state of complete stabilization. The heating periods employed extended over approximately 2 years. After treatments of different duration at elevated temperatures, some specimens were cooled and tested at room temperature; others were tested at the treatment temperature. For complete softening at 250° C., for instance, *i.e.* to obtain the properties observed is completely stabilized samples, heating periods of at least 6 months are required in the case of pure aluminium and Anticorodal, and of more than 2 years for Avional and "Y" alloy. A still longer heating time is necessary in the case of the alloy "R. R. 59."

✦ ✦ ✦

TO determine the decrease in strength of any material after heating for long periods at elevated temperatures it is necessary, therefore, to carry out tests of long duration.

✦ ✦ ✦

THE values of the yield-point observed in the normal short time test after heating periods of 1 year form a basis for calculations for engineers. The permissible loads can be ascertained only by observation of the creep limit, and this property is being studied by the authors.

✦ ✦ ✦

"An Anodic Treatment for the Production of Aluminium Reflectors" by N. D. Pullen.

✦ ✦ ✦

A DESCRIPTION is given of a dual anodic process designed for the treatment of aluminium

(*Please turn to page 732*)

Exports and Imports of Wire

(*Continued from page 725*)

gregated 1,437,425 square feet, a considerable increase over the August trade (134,675 square feet). The countries of supply were Germany (1,006,110 square feet), Belgium (300,525 square feet), the Netherlands (75,000 square feet), and the United Kingdom (55,800 square feet).

✦ ✦ ✦

Exports and Imports of Wire

EXPORTS of iron and steel wood screws during September, 1936 totaled 14,617 gross valued at $2,154. Of this total Cuba took 4,881 gross valued at $598; Mexico 1,563 gross valued at $281; Azores and Madeira Islands 1,325 gross valued at $136; Nicaragua 1,200 gross valued at $144; Canada 1,089 gross valued at $339; Panama 932 gross valued at $134.

✦ ✦ ✦

EXPORTS of brass wood screws during the same period amounted to 7,551 gross valued at $2,493. Of this total Brazil took 2,375 gross valued at $563; Canada 1,189 gross valued at $338; Panama 1,117 gross valued at $406; Azores and Madeira Islands 775 gross valued at $424.

✦ ✦ ✦

IMPORTS of wood screws during the same period amounted to 35,783 gross valued at $2,047, of which amount Japan supplied 33,700 gross valued at $1,869; Belgium 1,500 gross valued at $69; Sweden 330 gross valued at $35.

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British Institute of Metals Papers

(*Continued from page 731*)

surfaces in order to produce a high degree of reflectivity. The first bath in which the electrolytic brightening is produced is a mixture of sodium carbonate and sodium phosphate in the approximate proportions of 3 : 1 having a strongly alkaline reaction. The second bath in which a reinforcing film is produced consists preferably of a strong solution of acid sodium sulphate. Data are given showing the reflectivity of aluminium surfaces treated by this method compared with a standard silver mirror and other surfaces such as chromium plate, nickel plate, etc.

✦ ✦ ✦

"Study of the Forgeability of Various Light and Ultra-Light Alloys" by Professor A. M. Portevin and P. G. Bastien, Dr.-es-Sci.

✦ ✦ ✦

THE authors have endeavoured to determine by means of laboratory tests, the optimum conditions for hot-working light and ultra-light alloys. With this in view they have compared the results obtained from static bending and compression tests and dynamic bending and tensile tests. They have indicated the important part played by the rate of deformation, and have shown that the bending test appears to be the most convenient, speedy, and sensitive. The tests have been carried out on aluminium; on copper-aluminium alloys containing 6 and 12 per cent. of copper; on aluminium-magnesium alloys containing 5, 10, and 15 per cent. of magnesium; on magnesium; on magnesium-copper alloys containing 5, 10 and 15 per cent. of copper; and on magnesium-aluminium alloys containing 3, 6, and 9 per cent. of aluminium. The methods of testing employed have made it possible to define the capacity for hot-work of these various alloys.

✦ ✦ ✦

"Metals of the Platinum Group: Ores, Recovery and Refining, Fabrication and Uses, Properties" by R. H. Atkinson, M. A., and A. R. Raper, M. A.

✦ ✦ ✦

AN attempt is made to present up-to-date metallurgical information about the six metals of

the platinum group. After a brief description of the discovery of the metals and an account of the ores, particular attention is devoted to the recovery and refining of the metals produced from the Canadian nickel industry. This is followed by a full description of the methods of fabrication of the metals and their alloys. It is shown that the two ductile metals of the group platinum and palladium are readily worked, while rhodium and iridium are worked with much greater difficulty. The two metals osmium and ruthenium, belonging to the hexagonal system, have not up to the present been thoroughly investigated. Finally, an account is given of the properties of the metals and their uses.

✦ ✦ ✦

"The Creep of Tin and Tin Alloys. Part I" by Professor D. Hanson, D.Sc., and E. J. Sandford, B.Sc.

✦ ✦ ✦

THE paper describes results of creep tests of long duration on tin and some of its alloys in the rolled condition. Silver up to 3.5 per cent. greatly improves the creep-resistance of tin. Bismuth-tin alloys are more resistant to flow than pure tin at stresses above about 300 lb./in.^{2}, but at lower stresses they are inferior to pure tin. Antimony improves the creep properties of tin: the alloy containing 8.5 per cent. antimony withstands a stress three times that of pure tin for an equal duration. Cadmium-tin alloys are greatly improved by heat-treatment and offer considerable resistance to creep. The mechanism of failure of these alloys is discussed. Results are given of tests on lead-tin solders and on the cadmium-tin eutectic alloys: these flow under stresses as low as 130-150 lb./in.^{2}. It is shown that in many cases there is no relationship between resistance to creep and ultimate tensile strength.

✦ ✦ ✦

"Veining and Sub-Boundary Structures in Metals" by L. Northcott, Ph.D., M.Sc.

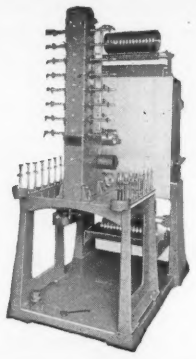
✦ ✦ ✦

A NETWORK structure, termed veining, which occurs within the crystals has been studied in several pure metals and in many alloys of copper, and methods for its production are discussed. The structure is shown to be due to the precipitation from solid solution, in a network form, of the oxide of the metal during cooling. The influence of alloying additions on veining in copper has been examined and the effect of heat-treatment and recrystallization on veining correlated with changes in hardness. Similar structures referred to as sub-boundary structures have been observed in a number of other alloys. These structures are due to the precipitation, also during cooling, of a constituent of the alloy.

"A Note on the Influence of Salt-Bath Heat-Treatment on the Corrosion-Resistance of Duralumin Sheet" by A. J. Sidery, Assoc. Met. and B. Evans, B.Sc.

✦ ✦ ✦

SOME experiments were carried out to provide information as to whether the use of a nitrate salt-bath as the medium in the final heat-treatment of Duralumin has any deleterious effect on the corrosion-resistance of the material as compared with that of material which has been heat-treated in an electric furnace.



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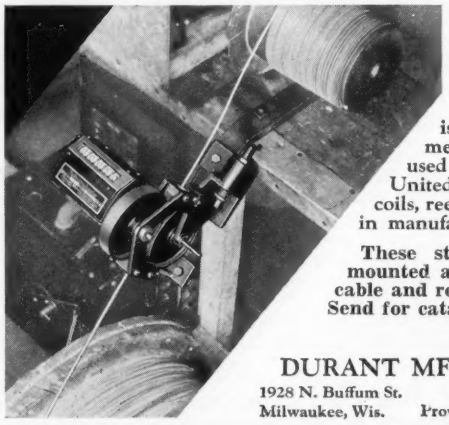

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✦ ✦ ✦

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INDEX

Covering the Principal Subjects and Articles Which Appeared in Volume 11 of WIRE AND WIRE PRODUCTS From January to December, 1936, Inclusive.

Acid Action 127
Acid Disposal 328
Acid Tanks—Storage 575
Adhesion of Galvanized Coatings on Steel Wire ..... By Ernest H. Lyons, Jr. 655
Alloy Steels for Spring 523
Alloys and Metals—Studies of 22
Aluminum Wire—Its Manufacture and Uses ..... By R. T. Griebling 69
Annealed High Carbon Wire For Springs 522
Annealing of Cold Drawn and Stamped Products 184
Annealing of Hot Rolled Products 185
Annealing of Non-Ferrous Metals 511
Application and Utility of "Bethanized" Wire ..... By L. H. Winkler 228
Arc Welding Electrodes 527
Arsenals and Laboratories—Work Performed 709
Atmospheres and Furnaces in the Wire Industry ..... By H. M. Heyn 507
Atmospheres—Controlled 510
Atmosphere—Controlled Applications 183
Atmospheric Corrosion Tests—A. S. T. M. 726
Austenitic Treatment for Cold Working 501
Bakers—Wire 423
Baking—Indirect-Fired 423
Baking—Rod 132
Barbed Wire ..... By C. M. Vandeburg 78
Basic Theory of the New Bethanizing Process ..... By U. C. Tainton 225
Beryllium Copper for Springs 592
Beryllium-Copper Wire has Unique Characteristics ..... By Jack Delmonte 326
Bessemer Wire For Springs 552
"Bethanized" Wire 225
"Bethanized" Wire—Application of 228
Billet Identification System 274
Billet Specifications for Stock 273
Bolt Stock—Heat Treating of 333
Bolt Wire 142
Brass for Springs 526
Brazing—Continuous 185
Bright Annealing High Carbon Steel Wire 518
Bright Annealing of Cold Rolled Strip 185
Bright Annealing of Non-Ferrous Metals 511
Bright Hardening 184
British Institute of Metals—Digest of Papers 40-730
Cable Developments in 1935 ..... By John Liston 47
Calculations of Wire Drafts and the Use of The Slide Rule in the Wire Mill, The ..... By Tom Gore, Jr. 173
Canadian Wire Industry 82
Carbon Oxygen Iron Diagram 509
Cascade Drawing of Copper 503
Cellulose Acetate Treatment of Textile Insulation ..... By E. B. Wood 25
Chrome-Vanadium Steel 523
Clean Annealing of Non-Ferrous Metals 511
Cleaning Bethanized Wire 227
Cleaning House—Youngstown Sheet & Tube Co. 277
Cleaning Houses in The Wire Industry ..... By A. F. Anjeskey 570
Clifford Elected President of the Wire Association 231
Coatings—Galvanized on Steel Wire 655
Coatings Produced by Bethanized Process 228
Coiling of Springs 705
Cold Drawn Products—Annealing of 184
Cold Heading Rod 134
Cold Heading Wire 134
Cold Rolled Strip—Annealing of 185
Cold Working of Metals Division Added to the Wire Association 640
Cold Working Process 498
Compression Springs 708
Conditioning Treatments 498
Controlled Atmosphere Applications to Heating of Ferrous and Non-Ferrous Metals ..... By T. B. Bechtel 183
Controlled Atmosphere Mechanics 516
Controlled Atmospheres 510
Convection Baking 423
Convection Heating 80
Copper Wire—Endurance Tests On 576
Copper Wire Tables—International Standard Values 610
Corrosion in Springs 426
Corrosion Resistant Metals Symposium—A. S. M E. 606
Crystalline Formation of Lead 696
Cylinder Face Wire Cloth—Wire Requirements for 15
Design of Mechanical Springs, The ..... By J. W. Rockefeller, Jr. 373
Development and Standardization of Types of Military Equipment ..... By Captain Frank W. Bullock 709
Diagram—The Carbon Oxygen Iron 509
Diamonds—Industrial 330
Die Sizes—Sintered Tungsten Carbide 567
Dies—Effect on Finished Product 230
Dies For Aluminum Wire 70
Dies For Shaped Wire 75
Dies For Tubing 75
Dies—Polishing of 555
Dies—Recutting Tungsten Carbide 555
Dies—Tungsten 72
Dies—Tungsten Carbide Applications 556
Dies—Tungsten Carbide—Finishing From Moulded Nibs 553
Dies—Tungsten Carbide—Handling Within the Die Room 553
Dies—Tungsten Carbide Requirements for Special 568
Digest—British Institute of Metals Papers 730
Direct Rolling of Metals 105
Disposal of Waste Acid 328
Drafting Tables for Wire Mills 221
Drafts—Calculations of Wire 173
Drawing Aluminum Wire 70
Drawing Square, Rectangular and Irregular Shapes and Sections 76
Drawing Square Wire—Aluminum 71
Dust Collector 108
Effect of Dies on the Finished Product, The ..... By James R. Longwell 230
Electrical Characteristics of Silk and Cotton 25
Electrical Conductivity of Beryllium-Copper Alloys 326
Electrical Measuring Instruments 632
Electrodes—Arc Welding 527
Electro-Galvanizing of Round Wire ..... By Arnold Weisselberg 281
Electro-Galvanizing Process 655
Electrolytic Tough Pitch Copper Wire—Endurance Tests 576
Endurance Tests on Electrolytic Tough Pitch and Oxygen-Free Copper Wire ..... By J. N. Kenyon 576
Equipment for Producing Controlled Atmosphere 514
Etching—Steel and Copper 430
Exhibits at 1936 Wire Association Meeting 646
Exports and Imports of Wire 32-90-135-188-233-288-334-388-440-577-658-716
Extension Springs vs. Compression Springs 631
Factors Affecting the Performance of Springs ..... By J W. Rockefeller, Jr. 426
Fatigue in Springs 427
Film—Lubrications—Investigations in 464
Forming Spring Ends 707
Formula for Computing Wire Rope Stresses 130
Formula for Determining the Modulus of Elasticity of Wire Ropes 176
Formula for Power for Cascade Drawing of Copper 503
Fourdrinier Wire—Materials for Weaving 15
Furnace—The Cyclone 80
Furnace for Steel Wire Rods in Coils 333
Furnace—Galvanizing 286
Furnace—Pit Type 279
Furnaces—Controlled Atmosphere 186
Furnaces in the Wire Industry 507
Furnaces—Normalizing and Spheroidizing 512
Furnaces—Patenting 513
Galvanized Coatings on Steel Wire 655
Galvanizing Furnace 286
Galvanizing—Hot 228-383
Galvanizing of Round Wire—Electro 281
Gases—Controlled Atmosphere 183
Grain Size and Crystal Structure 324

INDEX

Covering the Principal Subjects and Articles Which Appeared in Volume 11 of WIRE AND WIRE PRODUCTS From January to December, 1936, Inclusive.

Grain Size—Microscopic Examination of 649
Grain Structures—Typical found in Metals and Alloys.... 651
Great Britain Institute of Metals—Digest of Papers..... 252
Grinding—Roll 125
Grinding Wheels 150
Guards—Wire Machine 397
Hard Drawn Spring Wire for Springs 522
Hardness Produced by Cold Working 493
Heat Treating of Springs 706
Heat Treating Steel Wire Rods in Coils for Bolt Stock.....
.....By J. M. Brown 333
Heating of Ferrous and Non-Ferrous Metals 183
Heating—Radiant Tube 511
Helical Spring Under Axial Load 631
High Carbon Steel Wire—Bright Annealing of 518
Historical Data Relating to Hot Galvanizing Practice for Wire .....By J. L. Schueler 383
Hot Galvanizing 383
Hot Rolled High Carbon Steel for Springs 523
Hot Rolled Products—Annealing of 185
Indirect-Fired Baking 423
Industrial Diamonds .....By Morris Simons 330
Inhibitors .....By Kenneth B. Lewis 127
Instrument Springs .....By J. W. Rockefeller, Jr. 631
Insulation—Cellulose Acetate Treatment of 25
Insulation—New Requirements for Wire 458
Insulation—Rubber 459
Insulating Machine—New Type 29
Insulating Paper—Manila Rope 436
Keeping Pace With Progress .....By J. H. Shilling 273
Laboratories—Research 563
Lead—Crystalline Formation of 696
Lead Press Arranged for Vacuum Operation 699
Lead Sheath—Structure of 700
Lime—Effect of in Acid Conditions 328
Lime Tanks 574
Lindberg Cyclone Tempering Furnace, The 80
Lubricants for Aluminum Wire 70
Lubricants for Finishing of Roll Surfaces 126
Machines for Roll Grinding 126
Machine Guards—Wire 397
Machine—Insulating—New Type 29
Management and Research 561
Manila Rope Insulating Paper 436
Manufacture of Manila Rope Insulating Paper .....
.....By James F. Adams 436
Manufacture of Springs, The....By J. W. Rockefeller, Jr. 704
Mathematical Problems Encountered in the Wire Mill.... 173
McCarthy Receives Certificate of Honorable Mention 641
Meaker Process of Electro-Galvanizing 655
Mechanical Hysteresis 631
Mechanical Springs—Design of 373
Membership List—Wire Association 585
Metal From Which Wire is Drawn 494
Metallic Specimens—Preparation and Microscopic Examination of 378-430-648
Metallurgy of Arc Welding 527
Meter for Measuring Wire and Wire Rope 451
Method of Handling Tungsten Carbide Dies Within the Die Rooms, A .....By K. R. Beardslee 553
Microscopic Examination of Metallic Specimens .....
..... 378-430-648
Microscopic Examination of Metallic Specimens—Results Obtained 648
Modulus of Elasticity of Wire Ropes 176
Monel Metal for Springs 526
Music Wire for Springs 522
Nail Mill—Youngstown Sheet & Tube Co 297
New and Revised Standards for Wire 98
New Galvanizing Furnace, A .....By W. H. Spowers, Jr. 286
New Type of Insulating Machine, A .....By Austin Casey 29
Nickel Silver for Springs 592
Non-Ferrous Alloys for Springs 526
Non-Ferrous Metals—Annealing of 511
Normalizing 507
Notvest Receives Wire Association Medal 641
Occluded Gases 514
Occluded Hydrogen 227
Oil Tempered Spring Wire 522
On the Modulus of Elasticity of Wire Ropes .....
.....By B. M. Suslov 176
Oxygen-Free Copper Wire Tests 576
Paper—Manila Rope Insulating 436
Patenting 279
Patenting—Principles of 499
Patents—A Review of Recent Wire .....
.....34-92-136-190-234-287-342-387-442-600-660-718
Personnel Training 563
Phosphor Bronze for Springs 526
Plastic Deformation in Wire Drawing..By B. L. McCarthy 493
Plating Solution Control 610
Plugs or Mandrels 75
Polishing of Dies 555
Power for Cascade Drawing of Copper.....
.....By Paul M. Mueller 503
Preparation and Microscopic Examination of Metallic Specimens, The .....By G. W. Pirk 378-430-648
Problem of Retirement of Wire Rope from Service, The .....By B. M. Suslov 19
Procurement Planning—U. S. Signal Corps 712
Production Control Methods—Youngstown Sheet and Tube Co. 273
Program—1936 Wire Association Meeting 446
Progress in Engineering Knowledge During 1935.....
.....By P. L. Alger 22
Progress in Rod Baking Methods.....By J. R. Morrison 132
Racks—Sull 574
Radiant Tube Heating 511
Recent Developments in Steel Wire Technology .....
.....By S. A. Braley 322
Recutting of Dies 555
Reductions During Drawing of Aluminum Wire 70
Republic Steel Corporation—New Wire Mill 672
Requirements of Materials for Weaving Fourdrinier Wires .....By Hugh E. Brown 15
Research as Applied to Manufacturing....By C. W. Meyers 561
Research—Subjects for 564
Research—Government Laboratories 709
Rinse Tanks 574
Rod Baking Methods 132
Rod—Cold Heading 134
Rod Handling 276
Roll Grinding .....By J. R. Leonard 125
Rolling of Metals—Direct 105
Ropes and Stresses—Wire 130
Ropes—Wire—Russian Practice for 176
Rotation of Extension Springs 636
'Round the World With the Wire Industry .....
.....35-94-137-191-234-291-335-390-443-594-662-721
Round Wire—Electro-Galvanizing of 381
Round Wire Galvanizing—The Meaker Process 655
Russian Practice for Determining Life of Wire Rope 19
Russian Practice of the Manufacture of Wire Rope and Cable 176
Rust Proofing at Low Cost 103
Rust Resisting Steel for Springs 523
Scale Springs 633
Scale Springs—Load Deflection Characteristic 637
Selection of Wire Spring Materials, The .....
.....By J. W Rockefeller, Jr. 521
Silico—Manganese Steel 523
Sintered Carbides 566
Slide Rule in the Wire Mill 173
Some Recent Developments in Tungsten Die Practice.....
.....By James R. Longwell 72
Spring Brass 526
Spring Corrosion 426
Springs—Coiling of 705
Springs—Compression 708
Spring Ends—Forming 707
Spring Materials—Wire 521
Springs—Corrision-Fatigue 426
Springs—Creep Under Load 631
Springs—Elinvar and Related Nickel-Chromium Steels.... 631

INDEX

Covering the Principal Subjects and Articles Which Appeared in Volume 11 of WIRE AND WIRE PRODUCTS From January to December, 1936, Inclusive.

Springs—Heat Treating of 706
Springs—Instrument 631
Springs—Mechanical Hysteresis 631
Springs—Performance of 426
Springs—Principal Materials Used For 522
Springs—Temperature Effect on Modulus of Elasticity of 631
Standards for Wire 98
Straight Line Cleaning 570
Strain Distribution 496
Strain Hardening Removal in Aluminum Wire 70
Steel for Arc Welding Electrodes ..... By R. Notvest 527
Steel for Wire Drawing 499
Steel Wire Rods in Coils—Heat Treating of 333
Steel Wire Technology 323
Structure of Non-Vacuum Lead Sheath 700
Studies of Alloys and Metals 22
Sull Racks 574
Surface Alloying Process—English Development of 663
Syncro Insulating Machine 29

Tanks—Lime 574
Tanks—Rinse 574
Tanks—Steel Storage for Acid 575
Technical Discussions—1936 Wire Association Meeting 641
Tests—Accelerated Service for Inhibitors 129
Tests—Atmospheric Corrosion on Wire, Strand and Chain Link Fence 726
Tests—Pressure—Time on Lead Sheath 703
Textile Insulation—Cellulose Acetate Treatment of 25
Theory of the "Bethanizing" Process 225
Tools—Tungsten Carbide Application 556
Tungsten Carbide and Its Application to Dies and Tools ..... By A. R. Zapp 566
Tungsten Carbide Dies—Handling Methods 553
Tungsten Carbide—Requirements for Special Grades 568
Tungsten Die Practice 72
Turks Head—Drawing Aluminum Wire 71
Turks Head for Special Shaped Wire 76

U. S. Government Procurement Planning—Army 712
Vacuum Lead Sheath as Applied to Power Cable ..... By R. W. Atkinson 695
Valve Control—Remote 203
Waste Acid Disposal ..... By Kenneth B. Lewis 328
Weaving Fourdrinier Wire—Materials for 15
Welding Electrodes 527
Wheels—Grinding 150
Wire—Aluminum—Manufacture and Uses 69
Wire and Wire Goods Industry in Canade, The 82
Wire Association Attendance List—1936 Meeting 647
Wire Association Elects Clifford 231
Wire Association Meeting—1936 Program 446
Wire Association Membership List 585
Wire Association Moves Forward 640
Wire Association Questions and Answers
- Bolt Wire 142
- Cold Heading Wire 134
- Rod Production 134
- Wire Drawing 134

Wire Bakers, Past and Present ..... By Kenneth B. Lewis 423
Wire—Barbed 78
Wire—Beryllium-Copper 326
Wire—Bolt 142
Wire—Cold Heading 134
Wire Diameters Tabulated from One to Seven Passes 222
Wire Drafts—The Calculations of 173
Wire Drawing—Cascade Drawing of Copper 503
Wire Drawing—Plastic Deformation 493
Wire Drawing—Steel for 499
Wire for Fourdrinier and Cylinder Face Wire Cloth 15
Wire—Galvanized Coatings on Steel 655
Wire—Grain Size and Crystal Structure—Steel 324
Wire—High Carbon Steel—Bright Annealing of 518
Wire Insulation—New Requirements for 458
Wire—Metallurgical Characteristics for Arc Welding Electrodes 527
Wire Mill Drafting Tables ..... By Tom Gore, Jr. 221
Wire Mill—New for Republic Steel Corp. 672
Wire Quality 495
Wire Rope—Formula for Determining Life of 19
Wire Ropes and Stresses ..... By Richard Saxton 130
Wire Ropes—Modulus of Elasticity 176
Wire—Special Shaped 76
Wire—Steel—Recent Developments 323
Youngstown Sheet & Tube Co. Production Control Methods 273

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B

Balloffet Diamond Wire Dies Co., Inc. 729
Broden Construction Co. 734

C

Carboloy Company, Inc. 681
Cleveland Tramrail Division of the Cleveland Crane and Engineering Co. 719
Cochaud Wire Die Corp. 731

D

Dunscomb Associates 688
Durant Manufacturing Co. 733
Duriron Company Inc., The 729

E

Electric Furnace Co., The ..... Back Cover
Elevator Supplies Co., Inc. 727

F

Farrel-Birmingham Co., Inc. 721
Firth Sterling Steel Co. 694

G

Glader, Wm., Machine Works 720

H

Hallden Machine Co., The 734
Hudson Wire Company 684

J

Jagielski, Otto F. 734
Jones & Laughlin Steel Corp. 689

K

Kelly Wire Die Corp. 734
Keystone Steel & Wire Co. 725

L

Laclede Steel Co. 690
Lancaster, Allwine & Rommel 732
Lewis, K. B. 734

M

Master Wire Die Corp. 685
Meaker Company, The 687
Micro Products Company 717
Morgan Construction Co. 682
Mossberg Pressed Steel Corp. 730

N

New England Butt Co. 733
Norton Company 728

P

Parkin, Wm. M., Co. 731
Platt Brothers & Co. 734

R

Rebublic Steel Corp. ..... Front Cover
Robertson, John, Co., Inc. 724
Ross, J. O., Engineering Corp. 727
Ruesch Machine Co., H. J. 734
Rusch Wire Die Corp. 732

S

Schuyler, W. A. 734
Scott, Henry L., Co. 726
Scudder Foundry & Machine Co., E. J. 734
Seneca Wire & Mfg. Co. 734
Seymour Mfg., The 691
Shuster, F. B., Co., The 734
Sleeper & Hartley, Inc. 732
Spowers, W. H., Jr. 734
Surface Combustion Corp. 723
Syncro Machine Co. 718

T

Thomson-Judd Wire Machinery Co. 734
Twitchell, E. W., Inc. 734

U

Union Wire Die Corp. 692

V

Vanadium Alloys Steel Co. 693
Vianney Wire Die Works 728

W

Watson Machine Co. ..... Inside Back Cover
Wheeling Steel Corp. 683

Y

Youngstown Sheet & Tube Co., The ..... Inside Front Cover

BUYERS' GUIDE

For more complete information, consult the annual Directory, Index & Buyers' Guide.

ABRASIVES—
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ARMORING EQUIPMENT
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Seymour Mfg. Co., Seymour, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS—Rod and Wire
Lindberg Engineering Co., Chicago, Ill.
Morgan Construction Co., Worcester, Mass.
Morrison Engineering Co., Cleveland, O.
Ross Engineering Corp., New York, N. Y.

BORON CARBIDE—
Norton Co., Worcester, Mass.

CARRIERS—High Speed Braider
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin Co., The Wm., Pittsburgh, Pa.

CLEANING & PICKLING EQUIPMENT
Broden Construction Co., Cleveland, O.
Duriron Co., The, Dayton, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

COATING—Protective
American Lanolin Corp., Lawrence, Mass.

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.

COMPOUNDS—Cleaning
Oakite Products, Inc., New York, N. Y.

CONDUITS—Iron and Steel
Youngstown Sheet & Tube Co., Youngstown, Ohio.

CRANES—Block Stripping
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

CRANES—Cleaning House
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

CRANES—Electrical Traveling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

CRANES—Wire Mill
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIES—Diamond
Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Co., New York.
Driver Harris Co., Harrison, N. J.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Union Wire Die Corp., Stamford, Conn.
Vianney Wire Die Works, New York.

DIES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Balloffet Diamond Wire Dies Co., New York, N. Y.
Cochaud Wire Die Corp., New York.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Union Wire Die Corp., Stamford, Conn.
Vianney Wire Die Wks., N. Y.

DIES—Rod and Tube Drawing
Balloffet Diamond Wire Dies Co., New York, N. Y.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp, New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Union Wire Die Corp., Stamford, Conn.
Vanadium Alloys Steel Co., Pittsburgh, Pa.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Balloffet Diamond Wire Dies Co., New York, N. Y.

BUYERS' GUIDE, Continued

Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vanadium Alloys Steel Co., Pittsburgh, Pa.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
Balloffet Diamond Wire Dies Co., New York, N. Y.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Master Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Union Wire Die Corp., Stamford, Conn.
Vanadium Alloys Steel Co., Pittsburgh, Pa.
Vianney Wire Die Works, New York, N. Y.

DRAW BENCHES
H. J. Ruesch Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Machine Co., Trenton, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

ENGINEERS—Consulting Galvanizing
W. H. Spowers, Jr., New York, N. Y.

ENGINEER—Consulting Wire Mill
Lewis, Kenneth B., New York, N. Y.

ENGINEERS—CONSULTING—Non-ferrous Wire Mill
Jagielski, Otto F., Yonkers, N. Y.

EQUIPMENT—Galvanizing
Meaker Company, The, Chicago, Ill.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FILLERS—Paper for Cable
E. W. Twitchell, Inc., Phila., Pa.

FURNACES—Annealing
Electric Furnace Co., Salem, O.
Lindberg Engineering Co., Chicago, Ill.
Ross Engineering Corp., New York, N. Y.
Surface Combustion Co., Toledo, O.

FURNACES—Automatic
Electric Furnace Co., Salem, O.
Lindberg Engineering Co., Chicago, Ill.
Surface Combustion Co., Toledo, O.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Lindberg Engineering Co., Chicago, Ill.
Ross Engineering Corp., New York, N. Y.
Surface Combustion Co., Toledo, O.

FURNACES—Electric
Electric Furnace Co., Salem, O.
Lindberg Engineering Co., Chicago, Ill.

FURNACES—Hardening and Tempering
Electric Furnace Co., Salem, O.
Lindberg Engineering Co., Chicago, Ill.
Surface Combustion Co., Toledo, O.

FURNACES—Lead Melting
Electric Furnace Co., Salem, O.
Lindberg Engineering Co., Chicago, Ill.
John Robertson Co., Brooklyn, N. Y.
Surface Combustion Co., Toledo, O.

FURNACES—Non-Oxidizing
Electric Furnace Co., Salem, O.
Lindberg Engineering Co., Chicago, Ill.
Surface Combustion Co., Toledo, O.

FURNACES—Wire, Strip and Sheet
Electric Furnace Co., Salem, O.
Lindberg Engineering Co., Chicago, Ill.
Ross Engineering Corp., New York, N. Y.
Surface Combustion Co., Toledo, O.

GALVANIZING—Special Process
Meaker Company, The, Chicago, Ill.

GEARS—Wire Mill
Farrel-Birmingham Co., Ansonia, Conn.

GRINDERS—Roll
Farrel-Birmingham Co., Ansonia, Conn.
Norton Co., Worcester, Mass.

HANDLING EQUIPMENT—Material
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

HOISTS—Electric Traveling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

HOISTS—Monorail
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

INHIBITORS
American Chemical Paint Co., Ambler, Pa.
Parkin Co., The Wm., Pittsburgh, Pa.

INSULATION—Cable or Cable Filler
E. W. Twitchell, Inc., Phila., Pa.

LATHES—Die Reaming
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LIME—Pulverized
Amer. Lime & Stone Co., Bellefonte, Pa.

LININGS—For Acid Tanks
American Hard Rubber Co., New York, N. Y.

LUBRICANTS—Wire Drawing
R. H. Miller Co., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
John Robertson Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Brazing
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Bunching
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Machinery Co., Philadelphia, Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Chain Making
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coil Winding
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Coilers
Broden Const. Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co. Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Covering Wire—
Syncro Machine Co., Newark, N. J.

MACHINERY—Cutting
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Hallden Machine Co., Thomaston, Conn.
F. B. Shuster Co., New Haven, Conn.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Electro - Galvanizing Wire
Meaker Co., The, Chicago, Ill.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Extruding
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Forming
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Meaker Co., The, Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
H. J. Ruesch Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
John Robertson Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
John Robertson Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Material Handling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis., and Providence, R. I.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works Co., Chicago, Ill.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Pointing
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, O.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
Farrel-Birmingham Co., Ansonia, Conn.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila. Pa.
Broden Construction Co., Cleveland, O.
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Special—Combination Machine for Drawing, Cutting-to-length, Straightening and Reeling Bars from Coil in One Operation (Shumag Type)—
W. A. Schuyler, New York, N. Y.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Elevator Supplies Co., Inc., Hoboken, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.

BUYERS' GUIDE, Continued

Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Hallden Machine Co., Thomaston, Conn.
H. J. Ruesch Machine Co., Newark, N. J.
W. A. Schuyler, New York, N. Y.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
Elevator Supplies Co., Inc., Hoboken, N. J.
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing Wire
Henry L. Scott Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Elevator Supplies Co., Inc., Hoboken, N. J.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
W. A. Schuyler, New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
Elevator Supplies Co., Inc., Hoboken, N. J.

MACHINERY—Wrapping Wire
W. A. Schuyler, New York, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MONORAIL SYSTEMS—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

OVENS—Annealing or Drying
Lindberg Engineering Co., Chicago, Ill.
Ross Engineering Corp., New York, N. Y.

PAPER—Insulating
E. W. Twitchell, Inc., Phila., Pa.

PATENT ATTORNEYS—
Lancaster, Ailwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin Co., The Wm., Pittsburgh, Pa.

PICKLING—Tank Linings
American Hard Rubber Co., New York, N. Y.

POTS—Annealing, Case Hardening and Tempering
Lindberg Engineering Co., Chicago, Ill.

POTS—Lead Melting
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Farrel-Birmingham Co., Ansonia, Conn.
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REEL AND TENSION STAND—
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS—Impregnating
Mossberg Pressed Steel Corp., Attleboro, Mass.

REELS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Morrison Engineering Co., Cleveland, O.

RODS—Wire—Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

ROLLS—
Farrel-Birmingham Co., Ansonia, Conn.

RUST PROOF COMPOUND
American Lanolin Co., Lawrence, Mass.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.
R. H. Miller Co., Homer, N. Y.

SPOOLS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass, Zinc and Non Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.
Seymour Mfg. Co., Seymour, Conn.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TESTERS—Wire
Henry L. Scott Co., Providence, R. I.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VALVES AND FITTINGS—Acid Proof
Duriron Co., The, Dayton, O.

VULCANIZERS
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corp., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Enameled For Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Co., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio

WIRE—Nickel Silver and Phosphor Bronze
Hudson Wire Company, Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification For Special Purposes
Hudson Wire Co., Ossining, N. Y.
Seymour Mfg. Co., Seymour, Conn.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel and Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Seymour Mfg. Co., Seymour, Conn.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Co., St. Louis, Mo.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Co., Youngstown, O.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, Ohio.

WIRE AND STRIP—Brass, Zinc
Platt Bros. & Co., The, Waterbury, Conn.

This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

THE WATSON MACHINE COMPANY

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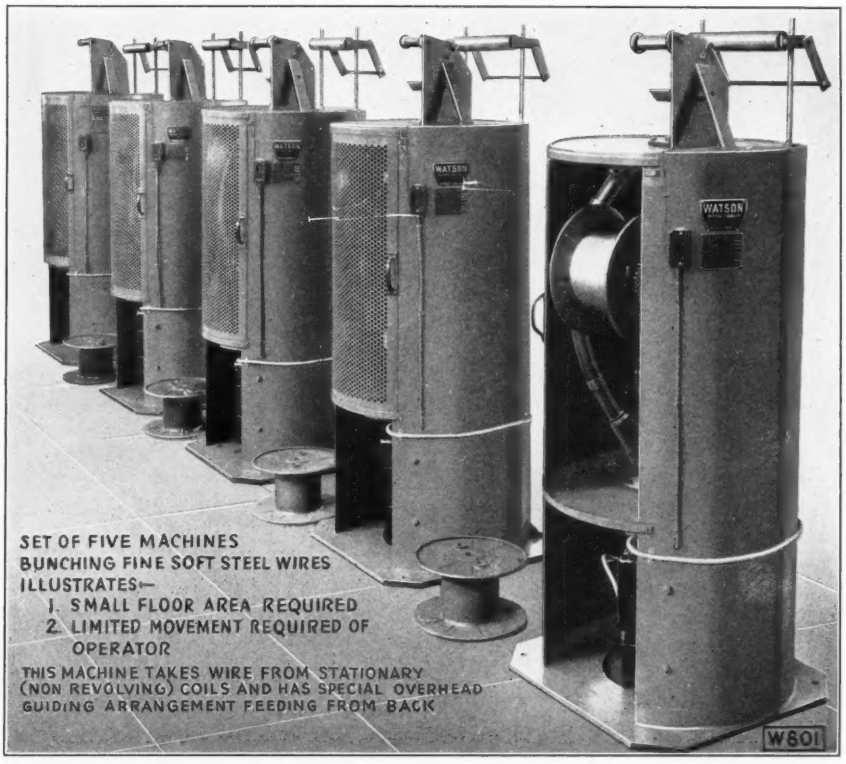
WATSON
WATSON
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2. LIMITED MOVEMENT REQUIRED OF OPERATOR
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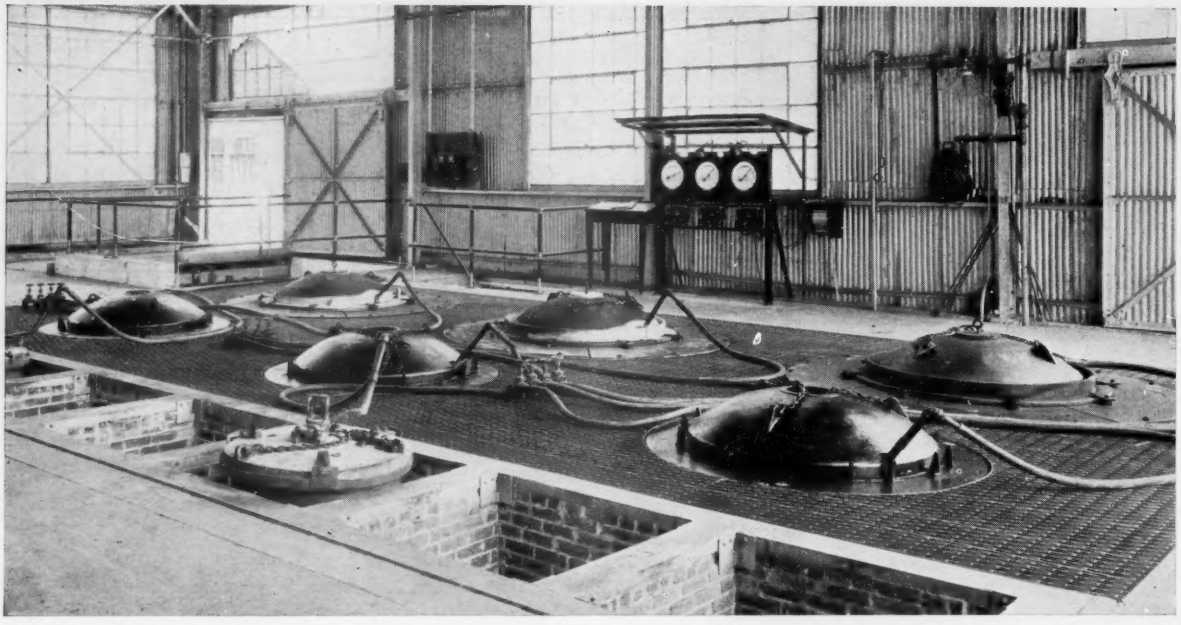
Small floor area, and automatic electric stops enable single operator to take care of eight machines with ease.

Send for latest bulletin and prices.



Another Pit Type Installation For Bright Annealing Wire

The above installation—another repeat order—is one of several recent pit type furnace installations made for bright annealing steel wire and normalizing rod.

Just recently we have been favored with repeat orders from several of the most prominent rod and wire mills in the country for these pit type annealers and normalizers.

These repeat orders include additional furnaces ranging from one to six per installation. Some are for annealing wire only, some for rod and others are to be arranged for handling both rod and wire in the same equipment.

These furnaces are fired with coke oven gas, mixed gases, natural gas or fuel oil.

All are being arranged for use with Elfurno controlled atmosphere because surface condition is becoming so increasingly important.

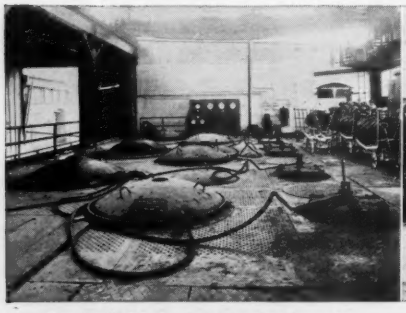
These repeat orders—from users with one and two or more years experience in the operation of the original installation—would seem to indicate that the original furnaces have given satisfactory service and confirm our claim that these furnaces turn out the most tonnage at the lowest cost with the most satisfactory surface condition obtainable and with the greatest flexibility of operation."

Other recent installations include furnaces for bright annealing copper wire, clean annealing brass wire, scale free hardening bolts, springs and miscellaneous products, as well as furnaces for billet heating, carburizing, copper brazing and other heat and heat treating processes.

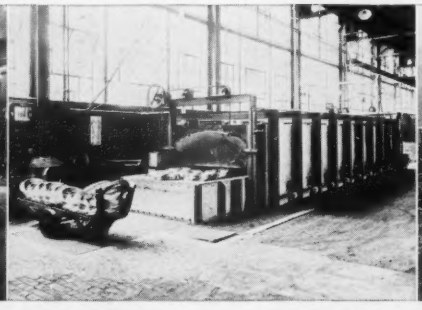
Additional information on these pit type annealers and normalizers or on any of the above furnaces gladly furnished on request.

The Electric Furnace Co., Salem, Ohio

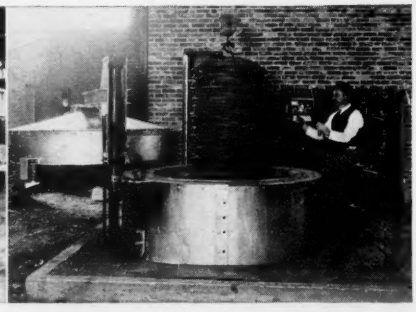
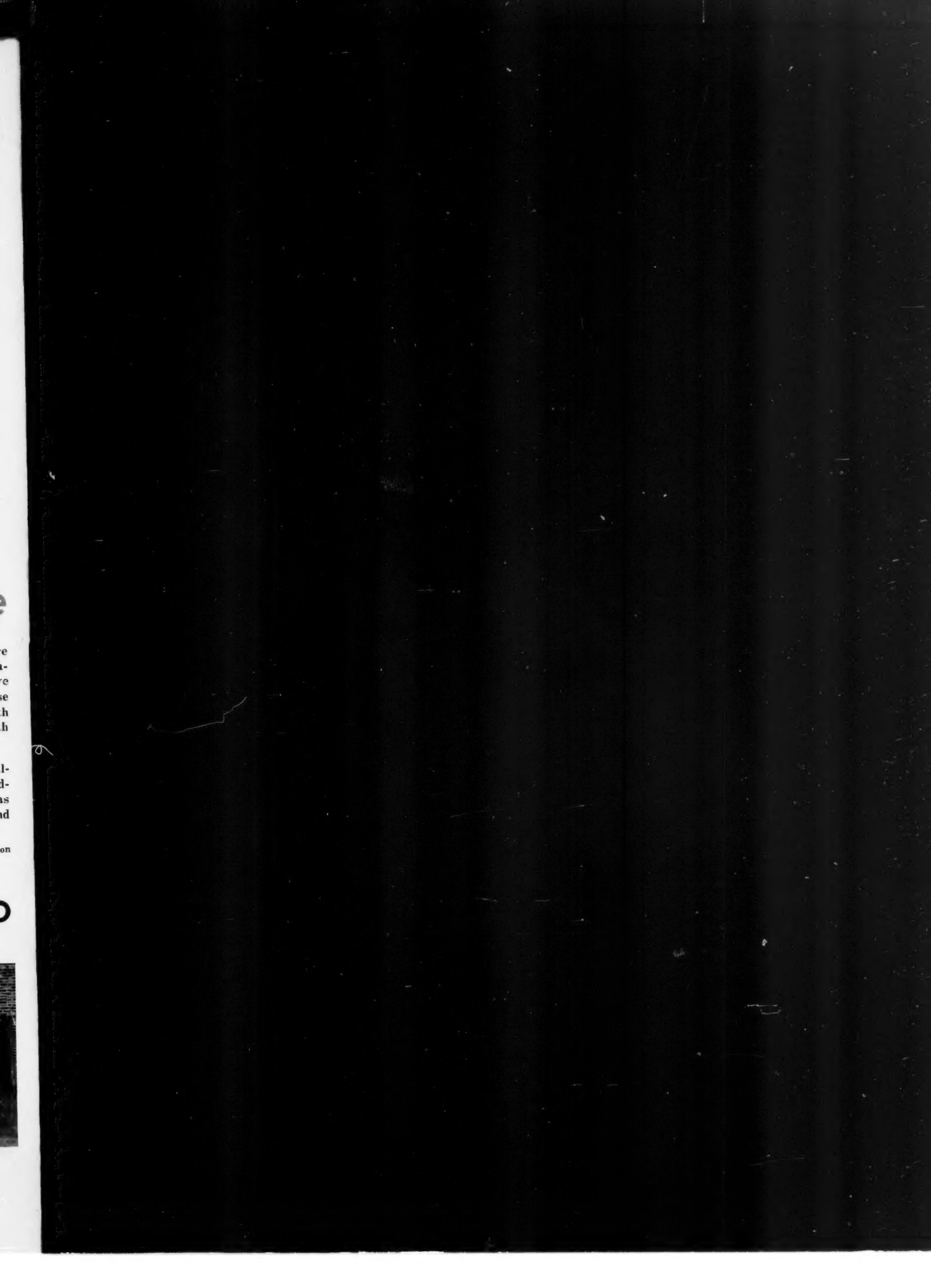
We Build the Furnace to Fit Your Job — For Oil, Gas or Electric Heat.



Gas-fired pits for bright annealing wire and normalizing rod.



Continuous conveyor type, gas-fired furnace for clean annealing wire in coils.



Electrically heated pit type furnace for annealing special alloy wire.